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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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The outcome of what it is hardly a stretch to call a "railroad session" of the New Hampshire legislature, preceded, as the session was, by a period of acute anti-railroad agitation, is of civic as well as economic interest. The bill, heretofore referred to, compelling the railroad companies to give free passes to the lawmakers died in the state senate after passing by a large majority the lower house of some 400 members, the largest state legislative body in the United States. The measure was vigorously resisted by the reformers and thus the smaller legislative body, contrary to the rule, became their citadel. Finally both houses adopted the wiser plan of having the state pay directly for the passes—a system already in practice in several states, and toward which many other states are gravitating. The other reform measures prominent in last autumn's political campaign struck rocks and went to pieces. The elective railroad commission—a measure, to say the best for it, of very doubtful wisdom—was rejected without discussion as was the much better measure to pay the Railroad Commission from the state treasury instead of "loading" its costs upon the railroads. It takes, evidently, a somewhat rare and fastidious legislative mind to measure the unwisdom and impropriety of any form of fiscal dependence between a public supervising body and the interests supervised. Taking the results, as a whole, of the anti-railroad movement in New Hampshire, they seem pretty vacuous. They contrast impressively with the recent drastic railroad legislation in Vermont, a state coterminous, with many elements of population similar to those in New Hampshire and *prima facie* the more conservative commonwealth of the two.

The Philadelphia & Reading has followed the Pennsylvania in raising the minimum age limit to be observed in hiring new employees. Men 45 years old may now be employed instead of rejecting all over 35. Two editors of active and academic mind have seized the occasion to philosophize on the "grave mistake" which these roads made when they established the limit at 35 years, and thereby declared that a man 44 years old is always less efficient than one 34. These wise editors should have inquired as to the fact; they would have found that their reasoning is all useless because their premises are wrong. The age limit was fixed primarily to insure equity in the granting of pensions to superannuated employees, and without special reference to the candidate's ability or skill in his work. Pensions are based in part on the length of the employee's service, and it would be unfair to encourage a man to enter a new service at the age of 40. To exclude him has the effect—at least an indirect influence—tending to keep him where he is and, consequently, in position to benefit by any pension that may come to employees of that road. In accepting men over 35 these two roads, driven by necessity, are looking out for the best available men for their service even at the disregard of this consideration in behalf of the employee. This necessity will also result in impairment of the road's interest and welfare in some cases; for most new men have to begin near the bottom of the ladder, and as promotion at the fastest occupies a series of years, men beginning, say, as firemen at 40, will in the natural order not become passenger enginemen till they are so old that they can give only a minimum number of years to that service. The company, if it gives such a man a thorough training, will spend an amount of time and money on the educating process disproportionate to the length of service to be received by it in return. This is only partly true of a man who has some experience before he is hired; but such men—men who change from one road to another after years of service—often have some deficiency which diminishes their value for the highest class of service.

Two railroad companies, neither of them among the strongest in the country, but both large systems, have, during the past week, refunded issues of short-term notes. The Erie sold $5,500,000 one-year credit notes, non-interest-bearing but sold on the regular discount basis of commercial paper. With the proceeds of these there have been refunded $3,000,000 6 per cent. notes sold last December, which matured on Monday of this week. The Wabash has $6,160,000 3-year 5 per cent. notes maturing on May 10. A new issue of the same amount and bearing the same interest has already been sold. The notes maturing are secured by all the stock and $6,600,000 of the 50-year first mortgage bonds of the Wabash Pittsburg Terminal Railroad. The new notes run for two years and are secured by this collateral and in addition by $4,800,000 of Wabash 4 per cent. bonds as well as $10,000,000 in stock of the Wabash-Pittsburg Terminal. It is reported that the funds thus obtained cost the Wabash 8½ per cent. and the Erie 10 or 11 per cent., the high rate in the latter case being because the notes are unsecured and the market is full of short-term notes issued by such strongly solvent companies as the Pennsylvania and the Louisville & Nashville, while the Erie, after its stormy history, has specially high fixed

charges. As a result there is little surplus left over after the first preferred and second preferred dividends, one or both of which may have to be passed in order to pay the face value of the notes a year hence. The expensive terms of the issue for the company, if these reports are correct, may be seen from the fact that it gets about $5,000,000 cash, for which it must pay $5,500,000 a year from now. The Erie has also $2,000,000 of six-month 6 per cent. notes maturing between now and July 3. It is evident that these maturing note issues have seriously failed of their purpose. A railroad issues short-term, high-interest-bearing notes in the expectation of being able to refund them during their life at a lower and more advantageous rate of interest, yet these issues have to be refunded by new temporary financing of the same sort at greater costs than the old issues. The outcome of this present situation is one of the most vital facts which affect the value of railroad properties. The railroad manager who can guess rightly the earliest time at which it will again be possible for his road to sell bonds at a fair rate is in a position to save it more money than he could in almost any other way.

"The amount credited as the gain of E. H. Harriman alone is placed at not less than $10,000,000 by many brokers."—*Wall Street Journal*, Aug. 17, 1906.

"Kansas City Southern advanced before the declaration of the preferred dividend, but the market shows very plainly that there has been none of that preliminary heavy inside speculation which did so much to disturb confidence and start the decline in stocks last year. The controlling interest has not been in the market."—*Wall Street Journal*, April 3, 1907.

These two brief comments selected from the "Features of the Market" column of the *Wall Street Journal* might well be made the subject of careful thought by those high railroad officers who feel that the financial difficulties with which railroads are confronted today are due only to the meddlesome activity of one Theodore Roosevelt, and that the distrust of railroad securities and railroad management has little or no justification. The fact that the railroads cannot borrow on reasonable terms the money necessary for improvements is due to a number of causes, in particular the great demand for capital in all lines of industry. An exceedingly important cause is the widespread distrust of railroad stocks and bonds. The comments noted above, it should be remembered, are taken, not from the editorial column, but from the current comment on the day's stock market sent out from hour to hour over the ticker. They represent, not the quiet and philosophical opinion of an editor in his study, but the swift judgment of market facts of a trained observer. We have several times taken occasion to condemn the Harriman dividend incident as an essentially unjust exercise of corporate power. It is a pleasure in contrast to record this frank opinion of the way in which the first dividend of the Kansas City Southern was declared last week. There is an added contrast between the two instances if one remembers that the Kansas City Southern was, up to two years ago, under the control of Mr. Harriman. The annual report issued after he retired was one of the severest indictments of a railroad management which has been made since the receivership era of 10 to 15 years ago. In brief, the roadbed, structures and equipment had been allowed to seriously deteriorate; traffic had (apparently) been diverted to other lines; there were over 600 wrecks in one year, and improper bookkeeping entries. Without attempting to pass on the truth of these charges, it is to be observed that the Kansas City Southern is now, in comparison with other roads, getting remarkably successful results from operation. The added fact that the men who control it are not using the road as the basis of a stock market campaign is another element of the company's present strength.

There are many indications that we are now seeing the beginning of a widespread epoch of corporate frankness, as already exemplified in the efforts of Mr. James J. Hill to explain fully and clearly the Northwestern situation whenever he has an opportunity to do so; in the extraordinary frankness with which Mr. E. H. Harriman told all he had to tell in the recent investigation and added much that was not required; in the establishment of a thoroughly good, systematic, press bureau service by the Pennsylvania, and in the frequent speeches made by Mr. Charles S. Mellen. The Southern Railway has been for years, and especially in recent times, a most notable example of a frank corporation, and its new President, Mr. W. W. Finley, goes even beyond the traditions left him by his predecessor. In the week ended March 23d, Mr. Finley made two characteristic addresses, each dealing with a separate part of the present situation, and an important one. At Spencer, N. C., he spoke to employees of the company on the occasion of the dedication of the Y. M. C. A. building at that place, and brought out no new points, but emphasized some old ones which can hardly be stated too often; the necessity for intelligent team work by departments and inside departments, the absolute dependence of the corporation upon the efforts of its employees, and extremely good chances for high promotion which an intelligent and capable young man has in railroad work to-day. Mr. Finley's other address was made before the Commercial Club of Birmingham, Ala., and here again he dwelt on some important truths which have been often stated, but are, nevertheless, habitually overlooked. He pointed out that the country at large and the South in particular could not thrive through damage to its railroads, that better passenger service is more important to the South than reduced passenger fares and improved freight service is more important, especially to Birmingham and to the state of Alabama, than any possible reduction in freight charges could be. Regarding legislative proposals to impose penalties on the roads for failures to perform services, Mr. Finley said in slightly different form what he has always said before, for all to hear, that the imposition of penalties for failure to furnish cars, etc., without regard to whether a railroad had a sufficient supply of cars to meet the demands or whether it was possible for it to procure from the car building companies all the equipment necessary in time to meet the demand, would not only fail to help the situation but would tend directly to make it worse, as every penalty imposed would reduce by so much the ability of the road to improve its service. It seems curious that after two generations of experience with transportation problems in this country, a railroad should have to beg a community not to penalize it for failure to accomplish the impossible, but there is plenty of this kind of legislation afloat at the present time. Both President Finley and his neighbor, President Garrett, of the Seaboard Air Line, have come with fresh strength and courage to an old problem, and both have started in by making it quite clear to the communities which they serve that the way to improve the very bad railroad service in the southern states does not lie in the imposition of penalties, in enforced reduction of tariffs, or in constantly increased taxation.

"Crelly, an operator in charge of the block station at Huske, 43 miles south of Richmond, on the Atlantic Coast Line, was reported to the chief despatcher this morning, as having been on continuous duty in charge of the block station at that place for 72 hours, without having been relieved. Superintendent Wooten said to-day that it was an unusual case, and was caused by the wife of the day operator having been taken seriously ill, so that her husband could not leave her, thereby necessitating Crelly's having to work an extra turn."

The foregoing is from a Richmond report in a recent issue of the *Washington Post*. Assuming that for a part of the day or night the trains passing this block station are infrequent, and that the operator in this case had the advantage of an assistant to awaken him on occasion, this report is not incredible. Enginemen and other trainmen do similar "stunts" by sleeping in their cabs or cabooses while another member of the crew keeps awake. Assuming these mitigating conditions, and assuming also that the men thus straining their nerves beyond the elastic limit have intelligent consciences and mean to take all possible precautions against errors, this way of running a railroad is not absolutely impossible. But the significant part of the item is the alleged statement of a superintendent that the conditions "necessitated" this overwork. We hear now and then of superintendents who aver that operators who have done such things as this broke the rules without their superiors' knowledge—an explanation that reflects on the ability of the superiors—but not often does an officer claim that such conduct is necessary. Such an assertion implies that the superintendent consented, or would have consented to the excessive hours. But what superintendent in his senses could be induced thus to consent? An order involving the safety of lives and property would thus be based on bald assumptions. There is a great difference between an operator trying to keep awake most of the time for 72 hours (or even 36 hours, which is a more common occurrence) and a superintendent or despatcher authorizing such hours. The officer may well believe that in a certain case this degree of endurance is possible without bad results, while yet, if reasonably conservative, he must refuse to countenance the attempt. This is a difference that seems to be lost sight of in many of the discussions concerning the rule to prohibit trainmen from remaining on duty more than 16 hours at a time. Ninety-nine men in a hundred may possibly be able to work long hours for a week at a time and even longer, and no harm ensue; but what thoughtful superintendent can for a moment think of authorizing 16-hour days on this assumption? He

is depending on 100 per cent. of good judgment and good conscience and 99 per cent. of good luck, when it is his duty to calculate on a minimum of these elements. He must allow for a low percentage of judgment and conscience and not depend on luck at all. In one aspect of the case the application by Congress of 16-hour law penalties to the employer and not to the employee is rational; for the employee's misconduct in many cases—such as going to a circus or a ball game when he ought to be asleep at home—cannot be made subject to rigid rules (except such as the man himself can establish in his own mind); whereas the officer, being unable to deal with the engineman's conscience and his personal habits when off duty, must of necessity work by a rule, even if it be an extravagant or troublesome rule.

CONTINUOUS RAILS FOR UNIFORM TRACK STRUCTURE.

The function of the rail in the track is to guide the wheels and to distribute the loads to the ties. The ties in turn distribute the loads to the ballast, and the ballast to the subgrade. This applies to lateral thrust as well as to vertical loads. These three distributors should be considered, each entirely separate from the other, and they should each be made to distribute the loads equally at all points along the track in order to have ideal conditions. Bad results come from expecting the ties or rail to bridge over a soft spot where the ballast is not performing its work uniformly, or from expecting the ties to do some of the work of a rail-joint that is not as stiff as the rail. If one of these distributing agents is required to do some of the work of another in addition to its own, at any one point in the track more than at another, then this one point is surely a weak one in the structure.

It is quite practicable to make the ballast conditions along the track almost uniform. The ties in themselves, of course, can be about the same, but in the rail structure, the joining of one rail to another seems to preclude uniformity, and it is very difficult to obtain in this structure exactly the same conditions throughout. Ideal conditions would be attained by a continuous unbroken rail, which would have no joints and would perform its function the same at every tie. This seems then to resolve the task into a problem of uniform splicing of the rails without any reference to the ties, rather than the solving of the long mooted questions, as to whether the joint should be of the suspended or supported type; whether one, two or three ties should help support the joint, or whether the ties should be considered as a permanent abutment for a bridge. If the rail structure throughout its length were in itself uniform in lateral and vertical stiffness, in its bearing on the ties, in its spiking facilities, etc., then all these other considerations of the tie in connection with the splice would be eliminated, and the ties could be placed wherever a good uniform spacing would bring them, as far as the assistance they render to the splicing of the rails is concerned. Railroads would then no longer be spending so much money renewing battered, bent and broken rail ends, or persistently driving ballast under the joint ties as fast as it disappears into the ground. All this trouble seems to be caused by periodic weak and otherwise uniform places in the jointed rail-structure. It is the lack of stiffness in the upper structure that permits the excessive deflecting of the ties, rather than the lack of bearing under the ties that permits the excessive deflection of the rail. This is precisely similar to the lateral conditions in which a lack of stiffness at the joints makes good alinement difficult.

Much of the present research and ingenuity seems to be exerted along wrong lines; all, perhaps, because in these considerations many people have been unwilling to isolate the ties from the joints, and persist in asking one to do part of the work of the other. The isolated splicing of the rails seems to be the fundamental problem, and the correct solution of it should be more generally accepted in the present efforts to strengthen track. With this problem solved, lighter rails would afford as good service as is now obtained with the large rail sections: not that the use of lighter rails is proposed, but what is equal to the same thing, the efficiency and strength of the present track could be greatly increased.

This analysis may seem theoretical and the task impracticable on account of being beset with so many difficulties. It is necessary, then, to look at these difficulties and to consider from the practical side what the conditions are, and what must be met in joining two isolated rails so that they will act like one when laid on the ties.

The two rails must be held together by a device as stiff vertically and laterally as the rail. This device should also have the same flexibility as the rail, should contain the least possible amount of material and the least number of parts. It should not touch the ties; but should allow the rail base or the tie-plates to afford the same bearing on the joint ties as on other ties. Spiking should be the same at the joint ties as elsewhere; except that it may be done in slots to prevent the creeping of the rail. This additional anti-creeping function of the joint will hardly interfere with it as a splice, if the spiking and bearing surfaces are otherwise kept the same at the splice as along the rail. Excessive or different spiking at the joints to compensate for a weak splice laterally makes rigid spots in the track and causes increased lateral wear at the rail ends. The splice must also hold the rails tight enough to give perfect safety and equal stiffness, and yet it must allow for expansion and contraction of the rails.

There are in addition to the requirements just mentioned, certain other difficulties imposed by natural and unavoidable limitations. The space around the rail ends is limited, and ideal conditions would not allow additions below the rail base on account of interfering with the ties and altering the bearing on them. This means that, if additions below the rail base must be used to get sufficient vertical stiffness, all such additions must be located between the ties; this, at the expense of having to adjust the ties somewhat, in order to clear the depending portions. Such adjustment, however, should not be a hardship, as the spiking facilities to prevent creeping are afforded at the same time.

It is now left to consider what appliances are available for meeting these requirements and limitations. This means, primarily, a criticism of the different types of rail joints, the best of which, necessarily, reduce the uniformity of the rail, from the fact that they are added parts; but the nearest approach to the ideal conditions is a splice bar rolled by several of the large steel companies. This bar has a stiffening flange to extend below the rail base between the ties, its end portions being cut away to clear the ties. This method of reinforcing the ordinary angle bar is as simple as it is effective, and it allows the use of the many good features of the angle bar which has stood the test for years. One of the best of these features preserved is, that the bars fit the rail only on two surfaces, which insures flexible adjustment and good tight-fitting contacts at all times, and in this they do not depend on any unusually accurate work at the rolling mills. It is obvious that a free depending flange can be designed and shaped so as to make the stiffness and flexibility of a pair of bars the same as a rail of any section, and also that the ordinary angle bar joint one-third as stiff as the rail can thus be transformed into one having the same stiffness as the rail. This reinforced type of bar is now standard on a number of the large eastern roads, and its popularity is rapidly extending to the various sections of the country where the heavy loads and increasing speeds are demanding stronger track.

There are several other designs of depending flange joints on the market, each with somewhat different characteristics. There is a tendency to make some of them of a light section and to rely on a shallow depending flange for stiffness. This, of course, is done in competition in order to produce a cheap bar. While these light bars give better service than the common angle bar, yet it is very evident that a certain amount of metal is required to make even these reinforced bars as strong as the rail.

Other types of joints not having depending flanges are numerous. Some can be made as strong as the rail, but in doing so too much metal is used, or the metal is so located that various irregularities are introduced, which counteract all the good effect of having a joint of the same strength and elasticity as the rail. Excessive stiffness, laterally or vertically, is just as bad as excessive weakness.

There have been some attempts to increase the stiffness of the common angle bar, and also other weak types, by making them of comparatively high carbon steel; but this has proven to be a great mistake, as the percentage of increase in stiffness is slight and the bars are more brittle and dangerous. The false economy of such a method is recognized when one considers that this practice simply means that the rail ends become worn in the fitting angles, instead of allowing the wear to be taken by the splice bars, which can be renewed at slight cost compared to the cost of the rail. After these fitting angles of the rail become worn by the hard bars, the rails ends cannot again be brought up to line and surface by renewing the splices. They are permanently damaged

and the result is further battering and ultimate renewal. The splice bars should always be of softer steel than the rail.

The increasing use of the different types of reinforced depending bars is a great step in advance. It clearly indicates the practical application of the line of thought here presented, and it may not be long until there will be a general acceptance of the uniform rail structure idea. This will mean improvement in design of the present appliances, as well as the production of new devices to meet more clearly defined requirements. But in it all, the one thing to be considered is, this fundamental idea of tying together the jointed rail structure, so that it will receive uniform wear throughout, as well as act on the ties and ballast with a uniform effect, and be as nearly as possible the same as a continuous rail. It is the failure of the most of the present rail structure to do this that not only makes trouble for the ties and ballast, but also causes battering and breaking of the rails and joints themselves. The railroad tracks must then be considered as made up of these three separate distributors: rails, ties and ballast, each, separately, to be made uniform throughout, one not requiring another to do part of its own work. This seems to be the correct principle to follow in meeting the demands for stronger and safer track. A little energy and thought thus rightly directed would go a long way toward saving some tremendous maintenance costs and, on many roads, would partly solve the problem as to whether or not train speeds must be reduced.

On April 4 the New York Central made tests on the line from Melrose north to Woodlawn to determine if possible, by actual trial, the speed the Brewster express was making when derailed on the Bedford Park curve on February 16, and also to find the maximum speed which a similar train could make on this stretch of track. Conditions were duplicated as far as possible, the test train consisting of two electric locomotives drawing five passenger cars weighted with sand bags to take the place of the passengers which the wrecked train had carried; the contact shoes on the right-hand side of one locomotive and on the left-hand side of the other were removed. The motorman ran the train according to directions given him by the motorman who had run the train when it was derailed. Two trips were made. On the first one the train reached a speed of 62.5 miles an hour at 183d street; at this point the controller, which had been at series-parallel with all resistance cut out, was brought down to series with all resistance cut out, as had been done at the time of the derailment. At Fordham, two-fifths of a mile farther, the controller was put back to series-parallel without resistance and the train rounded the curve a mile farther on at 48.9 miles an hour. The rails on the curve had been double spiked since the accident. The motorman of the wrecked train and several officials of the railroad testified before the New York State Railroad Commission that at the time of the derailment the train was running between 45 and 50 miles an hour. A number of passengers testified that, to the best of their knowledge, the speed was between 70 and 90 miles an hour at this point. The second test run was made to find the highest speed the train could make on straight track and at the curve. The line from Morrisania north to Fordham, 2.22 miles, is nearly straight, on an ascending grade of about 10 ft. to the mile. Over this stretch the motors were run wide open; that is, with the motors connected in parallel and all resistance cut out. The highest speed, 66.5 miles an hour, was made just south of Fordham. At Fordham the power was shut off while the train ran over some frogs and switch points, and five seconds later the controller was put at series-parallel without resistance, where it stayed until the curve was passed. The speed around the curve was 56.5 miles an hour. The locomotives took the curve without shock and with only a slight rocking. The distance from Melrose to Woodlawn is 5.68 miles. The schedule of the Brewster express at the time of the derailment in February made the time between these points seven minutes. The time for this distance on the first test last week, which was meant to duplicate the run of the train on the night of the derailment, was 6 min. 31 sec.; on the second test the distance was covered in 5 min. 48 sec. The following estimates of the speed of the New York Central electric locomotives were made about a month ago. It is to be noticed that these figures are not intended to show actual results, but merely the maximum speed at which the motors can revolve when connected up on the systems indicated. Between Melrose and 183d street the current is delivered to the locomotives at 600 volts; between 183d street and Fordham at 625 volts; and between Fordham and Williamsbridge at 650 volts.

Possible Maximum Speed, Running Light on Level Tangent Track in Still Air, with 600 Volts at Motors.

Position of controller.	Speed in miles per hour— One locomotive.	Two locomotives.
Controller in full series notch	28	30
Controller in full series-parallel notch	50	52
Controller in full parallel notch	86	90

CONTRIBUTIONS

The Profitable Weight and Speed of Freight Trains.

To the Editor of the Railroad Gazette:

I am pleased to see by the proof of Mr. Wild's article, which you were good enough to forward me, that the trend of opinion in railroad circles is beginning to swing away from the large train. From long practical experience under varying conditions, I have found that it is not economical to load engines down to their limit. In Canada, and I take it that it is the same in the United States, it is becoming more difficult all the time to attract the right type of men to the train service, and I attribute a great deal of this to the conditions governing in that service.

Many years ago I started out on the principle that the greatest economy was to be effected through loading engines to the limit, and like many of my confreres I overdid it. Finally I had to switch and found that more economy resulted from loading the trains so that they could get over the road in a reasonable time. Our engine districts here are approximately 130 miles. When we get our trains over in from eight to twelve hours, varying according to the density of the traffic, we have no trouble in keeping men, maintaining high efficiency and minimizing train accidents. Where it takes men from 18 to 24 hours to get a freight train over a 130-mile district, there is an excessive use of fuel and oil, engine failures be-more more frequent through bad firing as a result of the fireman's endurance being overtaxed, train and enginemen become logy and sleep in side tracks, and accidents result.

Apart from this phase of the question, the damage and wear and tear to rolling stock through overloading engines is tremendous, to say nothing of the damage to the contents of cars by the shocks consequent upon pulling out drawbars, resulting in the brakes going into emergency. In the territory that I have charge of, trains are loaded so that they can get over the road in good time. We use small eight-wheel engines on way freight trains, and principally very heavy 10-wheelers on our drags.

In my opinion the overloading of engines and strict adherence to seniority has done more than anything I can think of to prevent the most desirable type of men joining and remaining in the train service.

G. J. BURY,
General Superintendent, Canadian Pacific Railway.

Baltimore, Md., April 8, 1907.

To the Editor of the Railroad Gazette:

It was gratifying to note in your issue of March 8 that Mr. C. F. Noyes was able to confirm my table of load reductions for given increases of speed after making due allowance for terminal delays to engines. Mr. Noyes approaches the subject, however, very cautiously and does not venture to offer an opinion on net revenue results. I quote him as follows: "As to whether the net revenue accruing from the train hauled would show figures corresponding to results shown in number of hours that a given number of cars could be removed, or not, I am not prepared to say."

It is hoped that a perusal of this letter will assist him to a conclusion on the net revenue aspect of the case.

I will now deal with the letter of Mr. W. A. Worthington in your issue of March 29. I hope Mr. Worthington will not consider me unduly severe if I venture the opinion that he has completely begged the point at issue, and in doing so that he has given a most apposite illustration of the remark to be found in Mr. Noyes's letter that "As a rule it would seem that most operating officers base their loading and movement of trains on the showing a single train can make between any two terminals."

It is clearly obvious from my table that, granted the premises, a speed of 15 miles per hour accumulates more net revenue than a speed of 10 miles per hour within a given space of time, and this without an inch of additional track or another locomotive or car. In answer to this Mr. Worthington eliminates the element of time absolutely and fixing his mind purely on the motion element asks for more cars, locomotives and track room. He does not seem to see that the capital charge for his additional facilities would be an addition to the expense of operating at 10 miles an hour, so that his argument from the face of my table neglects an important item which if brought under consideration might actually knock the props from under his own reasoning.

The advocates of the big, slow moving train and the cheap ton-mile display, in my opinion, remarkable confusion of thought as to the connections between costs of operation and net revenues. What does it matter what is the cost of completing and paying for a period of railroad transportation provided the net revenue at the end of the period is more and provided that all the implements of operation have been maintained in proper working order. The operation of railroads is for the convenience of the public and for the accumulation of net revenue for those persons who have invested in them. The unavoidable conclusion from the reasoning of Mr. Worthington and gentlemen of his frame of mind—mostly graduates from the Jas. J. Hill school of thought—is that a rail-

road is a concern with which they are to be allowed to demonstrate triumphs of engineering skill in the magnitude of the locomotives, cars and trains which can be made to run on wheels, hang together and get over the prepared steel tracks at a crawling pace and with a fair measure of safety.

I am not prepared to admit, however, in view of present day developments, that the big train with slow speed is giving us a cheap ton-mile. This statement is apparently inconsistent with the figures of my table. But it is so purposely. It will have been observed that I maintain the value of the car-mile at 10 cents in each of my seven examples and that I reduced my cost per train-mile by nothing more than the cost of repairs per car-mile for reduced number of cars per train-mile. This method of constructing the table was not a very sound one but it was purposely used to give some one the opportunity of criticising it in the light of the ascertained results of operating the concentrated weights of the present day. As there has been no comment on this aspect of the case so far I must undertake a little self-criticism. I do not believe that it is proper railroad operation to run present day 100,000-lb. cars under load at the speeds requisite to give an inclusive speed of 15, 20 or 25 miles an hour. To adjust my table to these conditions I should therefore have to reduce the value of the car-mile by a stated sum. If we will again fix our minds on the two speeds of 10 and 15 miles an hour it would probably be necessary to reduce the car load at least 10 per cent. for the higher speed, and this would give, let us say, a car-mile value of 9 cents. Accompanying this reduction in car mileage and increase in speed, however, there would actually be very important reductions in costs per train-mile. There was a time not so very long ago when from 3 mills to 4 mills per car-mile was looked upon as an adequate rate of car maintenance and repairs. It is true this rate did not take care of much depreciation but there would seem no reason why with a decrease in concentrated weight and a consequent decrease in wear and tear the rate for repairs per car-mile should not fall back from 8 mills to 1.5 cents, where it stands to-day, to, let us say, 4 mills, and if we will add 1 mill to this rate to take care of a much less rapid depreciation than exists to-day we should have a total rate of 5 mills per car-mile for car repairs and maintenance as compared with the 8 mills used in my table. But in addition to this reduction the more rapid movement would give material reductions in the expense for overtime and fuel and stores consumption. What these would actually amount to, of course, it is impossible to say, but inasmuch as the overtime bills are proportionately three and four times greater than they were only a few years ago, and inasmuch as the miles got out of a ton of fuel are from 30 per cent. to 40 per cent. less, it is plain I should have made a liberal reduction in the expenses of my table on these accounts.

The original table gave a reduction of from 75 cents for a speed of 10 miles an hour to 71 cents for the speed of 15 miles an hour. Using all the factors just detailed there is ample warranty for reducing the 71 cents to 55 cents (the reduced rate of car repairs and the reduced number of cars would alone give a reduction of 14.5 cents), and at this rate the cost of making the 57,143 miles of the table would be $31,429, which actually gives a cheaper ton-mile than the 10-mile speed; therefore, on this basis we should have to deny to the advocates of the big train load even the solace of a cheap ton-mile.

To illustrate the advantages derivable from a comparatively small capacity car at a higher speed than 10 miles an hour one can use very advantageously an item of illustration which recently fell from the lips of Mr. E. H. Harriman.

Mr. Harriman described in a recent interview what he saw at some wayside station in New England of the way in which coal cars are held for unloading at stations of that character.

Taking the condition as he described it let us assume coal being delivered in 50-ton lots to small country dealers who have but one team with which to unload the cars. Let the further assumption be that the distance the coal is hauled is 180 miles, and that in one case it moves forward in two cars of 25 tons capacity each at 15 miles an hour, and in the other case in one car of 50 tons capacity at 10 miles an hour. Let it be assumed lastly that the delay for reloading the cars at the mines is one day in each case, and that the duration of the operation is a month of 30 days.

Now if it takes the consignee four days to unload 50 tons it takes him two days to unload 25 tons; therefore, the delay to one of the cars in case 1 is half of what it is to the other car in case 2. Therefore, the capacity of service of the first car in case 1 is as follows:

180 ÷ 15 = 12 hours + 48 hours + 12 hours for return trip + 24 hours at the mines = 96 hours between the first loading and the second loading.

720 hours ÷ 96 = 7.5 round trips.

Second Car in Case 1.

180 ÷ 15 = 12 hours + 96 + 12 hours for return trip + 24 hours at the mines = 144 hours between first loading and second loading.

720 ÷ 144 = 5 round trips.

We have, therefore, 12.5 round trips out of the two cars which at 25 tons to the car effects the delivery of 312.5 tons in 720 hours.

Case 2.

180 ÷ 10 = 18 hours + 96 hours + 18 hours for return trip ÷ 24 hours = 156 hours between first loading and second loading.

720 ÷ 156 = 4.62 round trips.

50 tons × 4.62 = 231 tons, delivery in 720 hours.

If the rate were $1.50 a ton the gross revenue in the first case would be $468.75 and in the second case $346.50. So much for the gross revenue.

Now as to the expense of the two operations we have already seen that the present cost per train-mile for train expense, round-house expense and maintenance of equipment is at least 75 cents per mile. We have also set forth circumstances which would admit of a reduction of this cost to 55 cents. Using these costs for the two cases we have the following statements, viz.:

40 cars at 75 cents is 1.88 cents per car-mile.
35 cars at 55 cents is 1.57 cents per car-mile.

Then with Case 1.

360 miles × 12.5 round trips = 4,500 car-miles.
4,500 car-miles at 1.57 cents = $70.65.

Case 2.

360 miles × 4.62 round trips = 1,663.20 car-miles.
1,663.20 car-miles at 1.88 cents = $31.27.

Case 1 therefore cost $39.38 more than case 2, but as case 1 has given us $122.25 more of gross revenue we have a net balance in favor of case 1 of $82.87.

Since writing the foregoing I have seen the letter of Mr. B. A. Worthington in your issue of the 5th inst., and I am bound to say that he begs the question almost as completely as Mr. W. A. Worthington. This is evident on consideration of his second paragraph. Will Mr. Worthington kindly say what he proposes to do with the 1,429 hours gained as per my table? It is true he speaks later on about increasing "the ratio of delayed time to total time to such an extent as to nullify the benefit which would be derived from handling the trains at higher speeds while actually in motion," but in considering the concrete example of his second paragraph he does not even acknowledge that there is any benefit whatever to be nullified. In dealing with his example his mind is evidently fixed on conjoining a higher motion speed with the present scale of delays while the essential point for determination is whether the possibility of higher motion speed will not reduce delays in sidings through facilitating the despatching of the trains.

While I have already stated my opinion that an operating ratio has no meaning whatever in the eyes of a railroad shareholder provided you can present him with an increased net revenue, I dissent from Mr. B. A. Worthington's statement that the increase of 43 per cent. in his freight train mileage would increase the entire operating expenses of his company 37.5 per cent. or anything like it. Using no more elements of reduced expense per train-mile than those mentioned in the first part of this letter, the 2,992,259 train-miles required for the 30 per cent. reduction in the load would cost at 55 cents per train-mile $1,645,742, while the actual 2,094,132 miles run at 75 cents cost $1,570,599. There is therefore an adverse showing for the smaller load of $75,143, but of course the point is that this amount is overcome by the 1,429 hours saved in the operation of the lighter train. It would be interesting to know on what theory Mr. B. A. Worthington jumps his entire operating expense 37.5 per cent. for an expense of 43 per cent. in his freight train mileage.

With regard to the difference between Mr. Worthington's and Mr. Henderson's scales of resistance, I was aware the difference was slight, but inasmuch as there has been what I will venture to describe as a perfect murrain of exact science in the loading of engines on railroads of late years which has not, however, prevented the overloading Mr. Worthington himself admits, I thought it well to draw attention to the difference such as it is.

I quite fail to see why Mr. B. A. Worthington should be surprised at my objecting to his describing a railroad with a general average rate per ton-mile of 5.13 mills as a high class road. I am willing to concede that a road with 12 per cent. products of animals, 29 per cent. products of manufactures, and 6.5 per cent. products of forests ought to be a high class road, and that it gets no more than 5.13 mills for its work despite its average haul of 250.2 miles evidences that somebody else than it is getting too much of the rate. When it is a matter of talking about high class traffic Mr. Worthington should remember that the lowest class traffic between Chicago and New York earns 5.5 mills per mile on the basis of a haul of 900 miles. Possibly he will be more surprised, however, if I am still more slow to appreciate the significance of his comparison of the haul and the revenue per ton on the two roads. Apparently he expects us to conclude that one road is a high class road because it receives $1.28 for each ton carried and that another road is a low class road because it receives 66 cents for each ton carried. On this theory a railroad should receive no more for carrying a ton of coal than a ton of dry-goods.

With regard to Mr. B. A. Worthington's concluding paragraph, few people seem to realize the debit to the account of the big car

for the simple reason that it is a big car and takes longer to unload. I have partially dealt with this aspect of the question in the foregoing and wish some one would help me out with the rest of it. I have heard it stated that ton for ton a big steel hopper does not dump as quickly as a moderate size wooden hopper. Why this is so I am sure I don't know unless it be that the lower strata of the coal cake and clog under the pressure of the upper strata; but I give the statement for what it is worth.

I am free to admit that the 43 per cent. increase in train mileage instanced by Mr. B. A. Worthington is a formidable looking figure, but if it is attacked in front, as I do not think it has yet been attacked, by the triple battery of decreased difficulty in despatching, decreased probability of breakdowns and increased speed of motion, and charged in flank by a full regiment of decreased expenditures per train-mile it may not prove as unsurmountable as it looks.

M. B. WILD.

Fallacies of Superelevation.

Detroit, Mich., April 8, 1907.

To the Editor of the Railroad Gazette:

That there is something the matter with the commonly accepted theory of the superelevation of the outer rail on railroad curves seems to have been suspected, but not investigated by Mr. Wellington when he said that there is something that "presses the outer wheel against the rail with tremendous force, however high the superelevation."

Since the frequent railroad accidents of the past few weeks have temporarily awakened an interest in the matter we find recent issues of technical journals telling us about balancing a considerable portion of the centrifugal force by superelevation of the outer rail, and that a superelevation of six inches in a track width of about 59 in. creates a counter force (centripetal force) of about 210 lbs. per ton relieving the centrifugal force by that amount. This theory neglects to take into account the lateral friction of car wheels on steel rails.

Assuming the coefficient of this friction to be 0.20, if we elevate the outer rail about 12 in. we shall just overcome this friction, and our theory of centripetal force will then begin to apply, and if we elevate an additional six inches we shall undoubtedly develop a centripetal force of 210 lbs. per ton as desired; but it takes 18 in. instead of six inches of superelevation to do it.

For reasons not necessary to mention here it is tolerably certain that we are not going to elevate the outer rail either 18 in. or 12 in.; and we may confidently say therefore, that within the practicable limits of superelevation there can be no centripetal force developed on a railroad curve, and that we need not hope to relieve the side thrust against the track either in that way or in any other way, and what we must do is to provide for it. All that we need expect to get out of superelevation is a little additional comfort and a little additional stability against overturning (perhaps 10 per cent. of the latter for a superelevation of six inches), not by means of any centripetal force created by the inclined plane, but simply because we thereby move the center of gravity a little further inward from the outside rail and in that way give it a little more leverage, but this does not diminish the side thrust against the track.

The ideal track should therefore be able to withstand a side thrust equal to the full amount of centrifugal force developed by a fast moving train, determined to be $.02335V^2D$ by Mr. Wellington. It seems surprising that even in the latest issues of prominent technical journals this fallacy of centripetal force is treated as though it were gospel truth.

JOHN A. FULTON,
M. Am. Soc. C. E.

Railroad Legislation in South Dakota.

The legislative session which has just closed in South Dakota gave much attention to railroad matters. The Governor was also "reform" but he did not go so far as did the legislature. He does not believe in fixing railroad rates, either passenger or freight, by an arbitrary inelastic legislative enactment. The commissions of different states should work in harmony in fixing rates and also be in touch with the Interstate Commerce Commission. He therefore worked for the passage of a law, which was enacted, which authorizes the State Railroad Commission to employ expert assistance, and learn the actual cash value of the railroads operating in the state for the purpose of fixing rates both passenger and freight, on an equitable basis.

The legislature attempted to enact a two cent passenger rate law but it failed in the house. Finally a compromise was secured in the passage of a law putting it within the power of the commission to fix passenger rates at a maximum of 2½ cents; but as the law providing for valuation for the fixing of rates went into effect before the rate proposition was enacted, there is no likelihood that any move on the part of the commission will be made to fix rates until after they have secured valuation figures.

While the legislature was playing with passenger rates the commission was at work on freight rates, in which they secured the co-operation of the roads. They took the Minnesota commodity tariff as a basis. In this a reduction of about 10 per cent. was agreed on. On request of the Governor the commission has prepared a simple rate sheet, from which any shipper can, with a known distance, easily figure what his freight charge will be on all important commodities. This tariff meets with the approval of the roads and will be accepted by them.

The legislature passed a law providing for the assessment of all property of railroads other than their tracks and fixing the rate of assessment on the tracks outside of towns at a different basis from that for tracks within towns. This Act the roads say will not be upheld by the courts.

A reciprocal demurrage law was passed. It makes a charge against the railroad for failure to deliver cars when ordered, and a fine of one dollar a pay for all time after 72 hours delay after ordering; with a like penalty on the shipper or consignee for failure to unload cars within 48 hours after notification of receipt of the same.

An anti-pass law was passed. It was made an "emergency" law, and went into effect immediately after its approval and filing. At that hour a number of the legislative members were on trains bound for their homes on a recess. The fact of the filing was at once wired to railroad headquarters, and it is reported that conductors took up passes as presented and caught a number of the members who had voted for the law, compelling them to pay fare for the balance of their trips to their homes.

Another law was to empower the railroad commission to order the construction of connecting tracks at all junction points in the state; to order waiting rooms established at such points, and to make joint through rates.

An employers' liability act was passed. It is like the national law, but it applies to all manufacturing and corporation activities.

An "anti-parallel" law was passed. The South Dakota Central is a local independent company which started to build into a territory which had long sought an extension of some of the older systems of the state. As soon as the new company began its line one of the old systems covered the same territory with a parallel road, and as the new company announced its intention of extending further into the field, the older one showed signs of following it up; and the law was enacted prohibiting a rival road to parallel another within eight miles unless it could secure the consent of the commission.

A law was passed to prohibit a railroad employee from working more than 16 hours continuously except in emergency, with eight hours rest after the 16 hours, one making all orders of the railroad commission valid, and placing the burden of proof on anyone attacking such orders; one taking the right of employment of counsel out of the hands of the railroad commission and placing it in the hands of the Attorney-General; preventing any railroad from abandoning any established station where the receipts, counting both outgoing and incoming, are as much as $1,000 in any consecutive three months, and at stations with smaller receipts only on written consent of the railroad commission; requiring railroads to pay double damage for live stock killed on their line where they refuse settlement out of court, and where on suit a judgment is secured for the amount of damage claimed; and another with the same provisions in regard to damages from fire set by engines or by railroad employees.

Corporations for profit are prohibited from making contributions to the candidacy of any person or party for political purposes; and lobbying is forbidden except by registered agents or attorneys, who are limited to presenting their cases to committees of the legislature.

A constitutional amendment will be submitted to the people of the state at the next general election to provide for a classification of property for the purpose of taxation, its main purpose being to allow the application of a gross earnings tax to the railroads of the state.

Foreign Railroad Notes.

In Manchester, England, last week a clerk in a mercantile house was prosecuted by the Lancashire & Yorkshire Railway for bribing a teamster of the railroad company to deliver a few parcels to a customer of the firm. As this was the first case under the new law which has been passed to prevent bribery in cases of this kind, the magistrate let the prisoner off with a fine of £1 and costs; but in this case the costs amounted to over $50.

George Gourlay, the engineman held responsible for the disastrous collision of passenger trains near Arbroath, Scotland, December 28, in a blinding snow storm, has been sentenced to five months' imprisonment. The number of deaths caused by the collision was 22, but the jury recommended leniency, and the magistrate imposed the shortest term permitted by the law.

Government Report on the Block System.*

(*Continued from page 483.*)

BLOCK SYSTEMS.

The several methods of block signaling or block working may be divided into three classes:

First.—That in which the signals themselves are operated manually, by signalmen, in accordance with information transmitted from one signalman to another.

Second.—That in which the signals work automatically; that is, signalmen are not required and the signals, moved by any suitable power, are so controlled electrically as to indicate stop or proceed in accordance with the presence or absence of trains in the blocks or of other conditions, such as open switches, affecting the safe movement of trains.

Third.—That in which the signals are operated manually but are so controlled by electrical devices that a signalman is prevented from setting a signal to allow a train to enter the block until the signalman at the other end of that block co-operates with him to release the controlling device. This form of the block system may and usually does include, either construction such that a train must pass out of the block before the releasing can be effected, or means by which the presence of a train in the block makes it impossible to give a clear signal.

Before the details of these three classes of the modes of block signaling are taken up, the signals themselves, which are, of course, common to all three, and the track circuit, which is the foundation of the systems of the second class and plays an important part in some of those in the third, will first be described.

THE SEMAPHORE.

The signal most generally used in all these systems is of the semaphore type, developed from the semaphore used for the transmission of messages before the invention of the electric telegraph. It consists of a vertical post or mast 20 to 30 ft. high, near the top of which is pivoted a movable arm nearly 1 ft. in width and 4 or 5 ft. long. The semaphore is placed at the right of the track and the arm projects to the right of the mast, as viewed from an approaching train that is to be governed by its indications. Where there are several parallel tracks the signals may be placed on a light bridge spanning the tracks and either a little to the right of, or exactly over, their respective tracks.

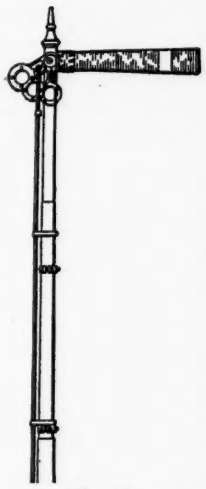


Fig. 1.

By day the necessary signal indications for the government of the enginemen are given by the positions of the arm. The arm horizontal, which may have a fancied resemblance to a bar opposing the passage of a train, means stop; an inclined position means proceed. In block signaling it is found to be necessary or desirable to give two different "proceed" indications—one meaning "proceed, block is clear," and the other meaning "proceed, looking out for a train in the block." The latter, known as the caution, or perhaps preferably the permissive, indication, is used to permit a train to proceed into an occupied block, with full knowledge, on the part of the engineman, that he must run carefully and look out for a train ahead, where, on account of the length of the block or the frequency of trains, it is not always practicable to detain one train until the preceding train has passed out of the block.

The permissive indication is usually given by an intermediate inclined position of the arm; on some roads it is given by inclining the arm upward. To make the three indications as distinct as possible, without making the arm work above and below the horizontal the positions 90 deg. and 45 deg. from the horizontal are used on some lines for the "block clear" and permissive indications, respectively.

Home and Distant Signals.—Signals with square ends to the arms are known as home signals, because they are usually located at or near the places from which they are operated. The home signal marks the point at which trains may be required to stop, and, when indicating stop, must not be passed by a train except in the case of a signal located in front of a station; it is usual to allow trains to move a short distance past such a signal in order to stop at the station platform.

To give the enginemen preliminary information as to the indications of the home signal, so that they may have no difficulty in stopping before passing it when it indicates stop, and may proceed at unchecked speed when it is clear, a distant signal is used. The distant signal is distinguished by a notch in the end of the arm. The horizontal position of the arm does not call for a stop at the signal, but cautions the engineman to be prepared to stop at the home signal; the inclined position of the arm is an indication that the home signal is clear.

Night Signals.—At night the indications are given by colored lights. An extension of the arm to the left of the center on which it works forms a frame in which one or more colored glasses are held. With the movement of the arm these glasses move in front of a lamp and give a red light when the arm is horizontal, commonly a green light for the permissive indication, and, by uncovering the lens of the lamp altogether, permit the white light to appear for the "block clear" indication. The distant signal also shows a white light when clear, but, although its aspect by day when indicating "prepare to stop at the home signal," is quite different from that of the home signal giving the permissive indication; it is common practice to use lights of the same color, green, for these two indications at night. This is mainly because of the difficulty in obtaining lights of a sufficient number of different colors and of the necessary degree of visibility. The semaphore arm is moved by a lever in the station or signalman's cabin, connected to the arm by means of rods or gas pipe or, in the case of a signal at a considerable distance, by means of wires. Semaphores are also operated, especially when used for automatic signals, by electric motors, fluid pressure, or other suitable power, electrically controlled.

Counterweighting.—It is obvious that a signal must be liable to failure in the performance of its functions, due to breaking or sticking of some part of its mechanism or of the operating means. A moment's thought will make it clear that, when a failure occurs, the conditions will be much better if the signal stays in the stop position than if it is left in the clear position. For, in the first case, nothing more serious should result than the unnecessary stopping of a train, while in the other event a train may proceed and run into danger when it should be stopped. It is therefore a well-established principle of signaling that signal appliances should be so designed as to cause the signal, upon the occurrence of failures of the most usual or probable kind, to go to, or remain in, the stop position. This condition is met in the construction of the semaphore by counterweighting the arm so that force must be used to bring it to the clear position, and in the absence of such force, it will take the horizontal position. The counterweight may be in the frame that holds the colored glasses or in a separate weight connected to the rod below the arm.

CLOCK-WORK SIGNALS.

An exposed disk signal is used to a limited extent as an automatic block signal. The disk or target is mounted on a vertical shaft revolved through a train of wheels by a weight that hangs in the hollow post; hence the name clock-work signal. Detents controlled by the armature of an electro-magnet hold the shaft at any quarter revolution according to the position of the magnet armature; that is, if the controlling circuit is closed and the armature attracted the shaft is held in either position that presents the disk edgewise to an approaching train, as an indication that the block is clear; the stop indication is given by the disk at right angles to its former position, when the circuit is open and the armature released. At night a lamp placed on the upper end of the shaft, provided with red lenses on two opposite sides and white lenses on the other sides, gives the proper indications as the shaft revolves.

Fig. 2.

INCLOSED-DISK SIGNALS.

A signal that is used to a much greater extent than the clock-work signal is the inclosed disk-signal. The disk, which is of very light construction and protected from wind and weather by the case and glass-covering opening, is easily swung to one side of the opening, as a proceed indication, by an electro-magnet and is returned by gravity to a position in front of the opening, as a stop indication, when the circuit is opened and the magnet ceases to attract its armature. The night indications are given by a lamp placed behind the small opening near the top of the case; a ring attached to a bar that forms part of the disk frame, carries the colored glass which is brought in front of the lamp opening when the disk covers the large opening below.

The disk signal has the merit of simplicity and cheapness both in first cost and maintenance. For this reason, and also perhaps because it is felt that automatic signals should differ in form from other signals, disk signals are in favor for automatic blocking on

*Besides the matter reprinted in this and other issues of the *Railroad Gazette*, the report contains a glossary of block signaling terms; a copy of the law of Great Britain, requiring the use of the block system on the railroads of that country; a copy of the law of Massachusetts, empowering the railroad commissioners to require the use of block signals; a statement of 13 collisions occurring within two years on the railways of the United States on lines worked by the telegraph block system, all due to errors or negligence of signalmen; a statement of seven collisions within the same two years on lines equipped with automatic block signals, all due to errors or negligence of enginemen; and a comparison of the American with the English records of employees killed and injured in train accidents in the four years, 1902-1905. From this last statement it appears that the numbers of employees killed and injured per 100,000,000 train-miles were as follows:

	1904		1903		1902	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
United States	76.8	557.8	86.7	577.8	72.3	491.2
United Kingdom	1.8	28.7	2.3	37.1	1.0	27.5

a few roads. It is, however, held by the majority of signal engineers and officers in the operating department, that the disk signal is, in the point of visibility, decidedly inferior to the semaphore. Except under favorable conditions as to light, it is difficult to see clearly at any considerable distance whether or not the disk is in front of the opening; at times sunlight is reflected from the glass in such a way that the disk cannot be seen; in winter snow sometimes sticks to the glass and obscures the indication.

Fig. 3.

The clock-work signal, while at a disadvantage, as compared with the inclosed disk on account of a somewhat complicated mechanism and in having moving parts exposed to the weather, is little better in respect to visibility; it is still much inferior to the semaphore on account of the small size of the disk or target.

Many clock-work and inclosed disk signals were installed during the early years of automatic signaling, because they were then the only signals that could be had at a cost that could be considered by most railroads. But since the development of automatic semaphores, successful in operation and reasonable in cost, the use of signals of the other two types has extended much more slowly, as it is generally agreed that, in distinctiveness and in the clearness with which its different aspects can be perceived at a distance, the semaphore surpasses all of the numerous other types and forms of signals that have been tried and used since railroads began to require fixed signals.

THE TRACK CIRCUIT.

The track circuit, used for the control of automatic block signals and also to actuate the releasing devices in the controlled manual system is illustrated in Fig. 4. The two lines of rails form the conductors for the electric current. At each end of the track-circuit section the rails are insulated from the adjoining rails by insulating rail splices, so that the flow of current is confined to the desired limits. To guard against interruptions on account of poor metallic contact at the rail splices within the circuit, bond wires, riveted to the ends of the adjoining rails, are provided at every joint.

The two terminals of a battery B are connected by wires to the opposite rails at one end of the section. The ends of the winding on an electo-magnet R are similarly connected at the other end. The opposite rails are imperfectly insulated from each other by the ties and ballast, but while a certain amount of the current is wasted by "leaking" across from one line of rails to the other, a sufficient quantity flows from the battery through one line of rails, through the wire of the instrument, and back through the other line of rails to the battery, to energize the magnet and produce the desired effect. The practicable length of the track circuit is limited by this "leakage" of current, but there is usually no difficulty with sections one-half to three-fourths of a mile in length, and, under favorable conditions, lengths of one mile or more are worked successfully.

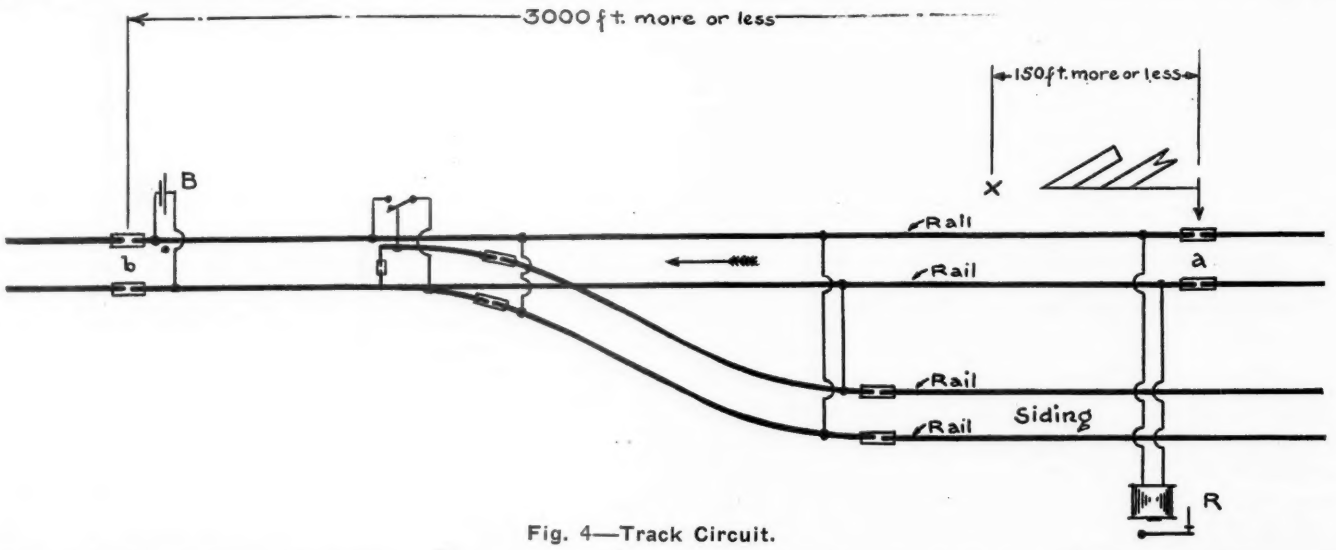


Fig. 4—Track Circuit.

The wheels and axles of a train, by making a good metallic connection between the opposite rails, form a "short circuit" or "shunt," through which passes nearly all the current given out by the battery. The flow of current in the wire of the instrument R is thus practically cut-off and the magnet is de-energized. The breaking of a rail or of any other part of the electrical conductors of course has the same effect on the instrument. As the available current is small, the instrument R, known as a track relay, is usually of delicate construction. It does not operate or mechanically actuate the signal, but merely serves, by means of contacts attached to its armature, to complete, when the track circuit is clear, or interrupt, when the track is occupied by a train, one or more other circuits directly controlling the signals.

Failures.—In addition to the most usual failures common to all electrical circuits, due to broken conductors, loose connections and similar causes, the track circuit is especially subject to failures on account of increased leakage resulting from bad-track conditions or wet weather. Failures from these causes are "on the safe side," that is, they cause the signals to indicate stop when the block is clear. With proper construction and maintenance, however, the frequency of such failures is not so great as to interfere with the usefulness of the track circuit.

Dangerous failures of the track circuit are probably not more numerous than similar failures of the other circuits and devices connected with automatic signals; and, as records and experience show, the total of such failures is relatively very small. But they have unquestionably increased in number with the extension of electric railroads in the vicinity of steam roads using track circuits. The stray return currents of electric roads find their way through the earth to the rails of steam roads, and when of considerable strength or under certain combinations of circumstances, cause the magnets of track relays to be energized when trains are on the circuits. One method of securing at least partial protection against failures from this cause consists of connecting a second relay at the end of the track circuit at which the battery is connected, which may be de-energized by a train even though the relay at the other end of the circuit should be energized by stray currents.

THE TELEGRAPH BLOCK SYSTEM.

In simple manual block working any convenient means of communication may be used. With electric bells the necessary inquiries and information may be sent from one man to another by means of a code consisting of various numbers of taps or rings and combinations of numbers separated by pauses. The telephone serves still better or might supplement the bells by furnishing the means for explanations not provided for in the bell code. The Morse telegraph is most extensively employed, however, because its use in railroad working in America preceded the adoption of the block system and, when any line has undertaken block working, the telegraph has been already available; hence the general name, "telegraph block system."

Both the appliances and the working of the telegraph block system are very simple. At each block section there are erected signals to govern movements of trains in each direction (or a signal for movement in the proper direction on each track, where there are more than two main tracks). Each signal may give two indications, "stop" and "proceed, block is clear," or three indications, "stop," "proceed, block is clear," and "proceed, block is occupied by a preceding train," according to the conditions or method of operation. Where the traffic is moderate the signals are usually erected at the regular stations and operated by telegraph operators who perform other duties at those stations. If some of the distances between stations are inconveniently great, or if other special conditions make it necessary, additional block stations may be opened. Where traffic is heavy and the operators' full time will be taken up with the block signal work, separate buildings may be provided for the signalmen and placed with more particular reference to the most suitable lengths of blocks or to the location of junctions, yards, etc.

Signals.—Signals having on the same post signal arms governing trains in both directions, are used to a considerable extent on account of the simplicity of the connections and the low cost, and their use is regarded as allowable practice; but they are objectionable because the signal for one track is necessarily on the left hand (wrong) side and, in fact, over beyond the adjoining track, and also because it is occasionally necessary for trains to pass stop

signals in order to get up to station platforms or reach sidings. A much better arrangement is to erect a separate post for each track and locate it in advance of the station so that there will ordinarily be no occasion for trains to move beyond stop signals.

For the sake of economy the telegraph block system has been installed to a great extent without distant signals. Where trains are at all frequent and the speeds of some trains are high, the absence of distant signals is a serious weakness in any signal system, for the reason that trains must either lose time by approaching carefully all home signals that cannot be seen at an ample distance, or must take chances by keeping up their speed at the risk of passing a signal if it is found to be in the stop position. If discipline is good, however, and trains are not allowed to overrun stop signals, the lack of distant signals is not necessarily a dangerous condition.

Permissive Blocking.—Obviously, if but one train at a time were to be allowed in a block, and a considerable number of trains were to be moved over a given line each day, or the movement of several trains in a short space of time without delay were to be provided for, short blocks would be necessary. Short blocks, however, mean large cost for operation, on account of the large number of signalmen that must be kept on duty. In practice, therefore, the length of block must be greater than the ideal length, which would permit the given train movement with only one train in each block, and must be a practicable length, governed by the possible expenditure for block operation, or fixed, in many cases, by the necessity of combining the block stations with the regular stations. With these longer blocks some of the trains must be admitted to blocks occupied by preceding trains—the method of operation known as permissive blocking—since, under this method, a train is permitted, with due warning, to enter a block that is not clear.

The usual practice is to allow freight trains, and in many cases passenger trains, to enter blocks occupied by freight trains, but to allow no train to enter a block occupied by a passenger train except by special order, naming the train ahead to be looked out for. Where freight traffic is heavy the permissive movements are regularly made on a third indication of the block signal, already mentioned, meaning "Proceed; block is occupied by a preceding train." Where traffic is lighter absolute blocking (that is, allowing but one train at a time in a block) may be the rule and permissive movements are then made only in special cases by order of the train despatcher.

Operation.—In operating the telegraph block system each signalman keeps a train record, on which he notes the passage of each train and the information he receives from the signalmen at the neighboring stations as to the approach of trains or their passage out of the block ahead. In the simplest manner of operation the signalman, when he is informed that a train is approaching, if his record shows that the block ahead is clear, clears his signal for the train to proceed. When the train passes his station he notifies the signalman ahead and reports to the signalman in the other direction that the train is out of the block that it has just left. The signalman ahead clears his signal for the next block, if that block is clear, and the signalman in the rear is free to admit the next train that may approach. If, after one freight train has been admitted to the block, a following train approaches before the first has passed out of the block, the signalman, where permissive blocking is regularly carried on, simply sets his signal in a position to permit the train to proceed and to indicate to the engineman that the block is occupied.

Under a more elaborate method of operation the signalman may consult the signalman in advance—that is, go through a form of asking his permission—each time before admitting a train to the block. This practice serves as a check on possible mistakes of the signalman, who, if he depended on his own record or memory, might some time admit a train in error when the block was not clear. This method is necessarily followed on single track, where the purpose is to prevent trains, through possible misunderstanding, from meeting between block stations, as well as to prevent one train from overtaking another.

The only appliances required for block working, as above described, aside from the signals, are a telegraph line and a set of telegraph instruments at each station. The line used for block communication is usually cut into sections, each taking in three or four stations.

Details of Operation.—Referring to the diagram (Fig. 5) which shows several arrangements of signals at three block stations, A, B and C, if a train moving east is approaching A, the signalman there will, if the block is clear, display the "Proceed" indication at A. As the train passes his station A reports it by telegraphic numeral, 4, to B. When the whole train has passed the signal, as shown by the presence of the "marker" flags or lamps carried on the last car, A returns his signal to the stop position. The train having been reported by A, B performs the same operations as to block, B C, and, when the rear of the train is 300 ft. beyond his signal, B, which has been returned to the stop position, reports the block clear of that train by "2" telegraphed to A. If permissive blocking is practiced, in the case of one freight train following another, each train admitted to an occupied block (by the proper signal indication or by caution card) is reported in the block by A, for example, and clear of the block by B, when it passes his signal; when his block record shows that all trains admitted have been reported clear, A may clear his signal for the next train that approaches.

If a train is to cross from the westward to the eastward track just west of C, it is the duty of C not to permit the train to cross if a westward train is approaching in the block B C; if, however, that block is clear, he must arrange with B to protect the train about to cross over exactly as he would protect an eastward train that had entered the block at his station.

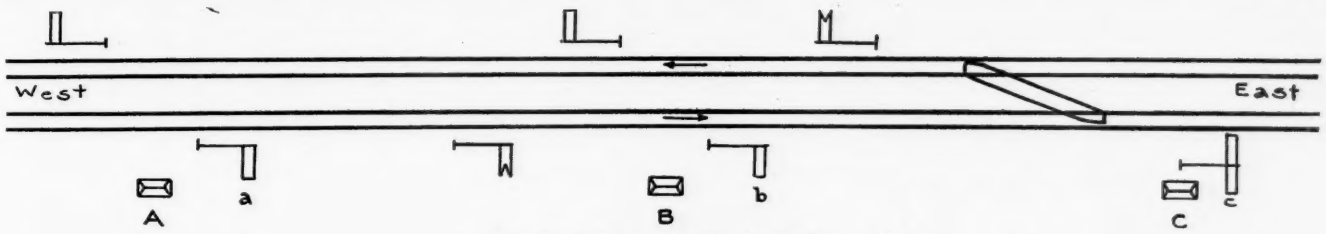


Fig. 5—Telegraph Block System.

Single Track Block.—On single track line trains are governed, with relation to trains moving in the opposite direction, by the time-table and the telegraphic orders of the despatcher. But mistakes, resulting in collision, are occasionally made, and it is obvious that the block system can readily give to each train the protection of signals against trains coming toward it, and so afford a safeguard that will be likely to prevent disastrous results in case of mistake or forgetfulness as to the rights of trains. All that is necessary is that A, for example, before admitting a train to the block on single track, should make sure that B has not previously admitted a train in the opposite direction which has not come through the block, and that B understands that a train is to be admitted at A, and will keep his signal for that block in the stop position against trains moving in the opposite direction until the train arrives at B. Where there is a passing siding within a block, say between A and B, and, on account of the expense, it is found to be impracticable to maintain an additional block station at such siding, the rule must, of course, be temporarily suspended when it is necessary to let trains leave A and B at about the same time to meet at that siding. In such cases, however, the trains are warned by the caution cards issued to them that the situation is exceptional.

Closing Stations at Night.—On some lines where trains, more especially passenger trains, are fewer at night than in the daytime, day signalmen only are on duty at certain block stations. On most railroads these stations are closed and reopened in accordance with the following rules:

338. To open a block station the signalman must give "8" to the next block station in each direction, and record the trains that are in the extended block. He must then display the normal signal indication, and notify the block station in each direction that the station is open.

When trains, which were in the extended block when the station was opened, and which had passed his station before it was opened, clear the block in advance, he must repeat the record to the block station in the rear.

He must not display the "clear" signal until all trains are clear of the block in advance.

339. A block station must not be closed except upon the authority of the superintendent; nor when trains are approaching which are to meet or pass at that block station.

340. To close a block station the signalman must first obtain "2" for trains which he has admitted to the blocks in each direction.

He must give "9" to the next block station in each direction, and transfer the records of the trains in the extended block. He must then enter on his block record "13," with the time it is received from each block station.

The block signals must then be secured in the clear position, all lights extinguished, and the block wires arranged to work through the closed station.

While a station is closed the two blocks on each side of it are thrown into one; that is, if B is closed the block is AC, and A carries on the block signal work with C exactly as he did with B, when that station was open.

Signalmen.—Although the procedure in block-signal working is very simple, so that, aside from the use of the telegraph, the work could be done by any ordinarily intelligent person after a little study, a moment's thought will show the vital importance of good intelligence, coolness, a clear head, good habits, conscientiousness, and a sense of responsibility on the part of each signalman. The

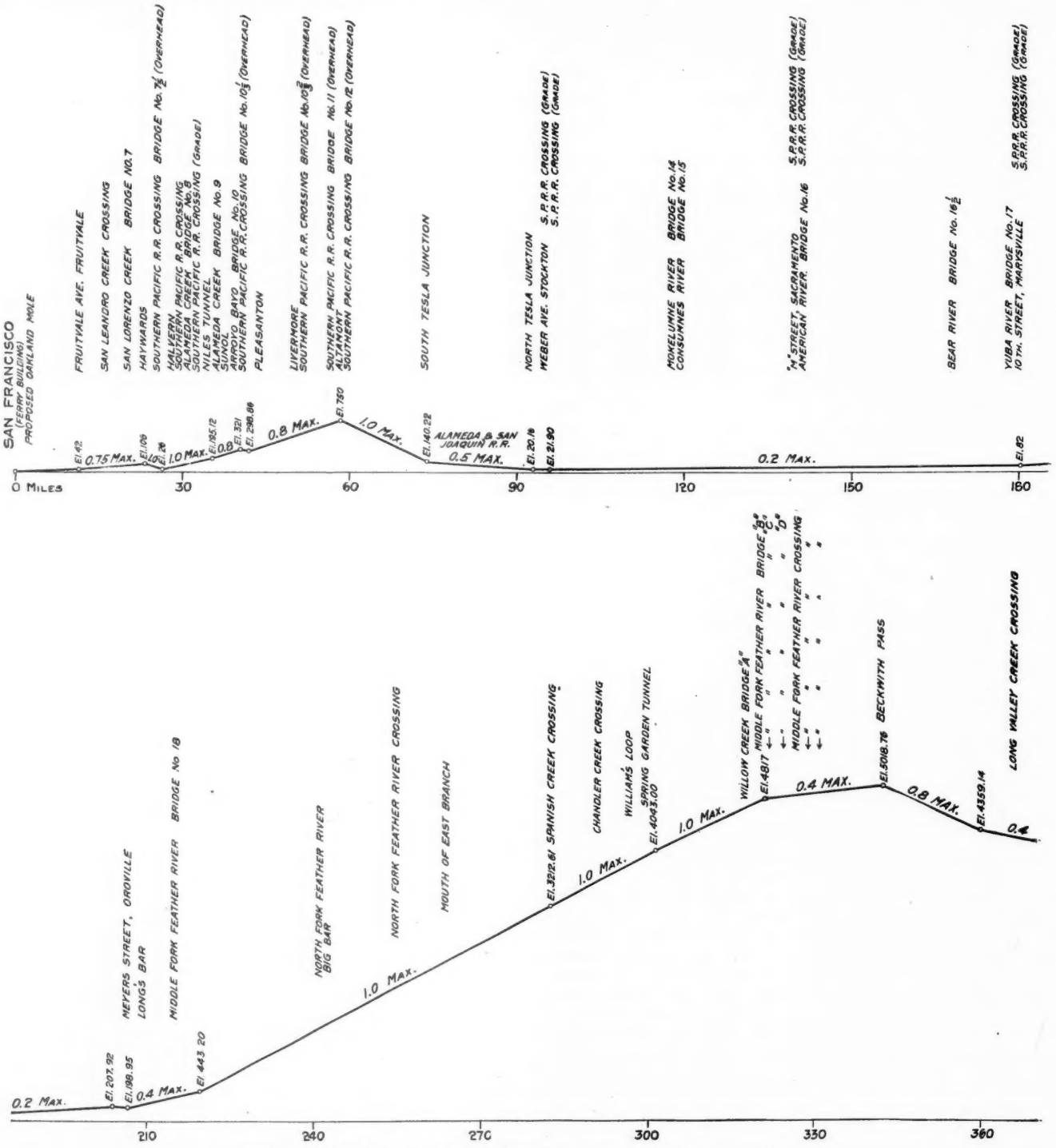
safety of trains is secured, not by the doing of a few simple acts which a child could perform, but by the vigilant habit of mind and thoughtful attention to each thing done that will eliminate or keep at a minimum the always possible mistakes of forgetfulness.

(*To be concluded.*)

The Grades of the Western Pacific.

The route and construction of the Western Pacific have been described in the *Railroad Gazette* March 16 and September 28, 1906, each time with a map showing the line of the road. The most striking thing about this new Gould road to Pacific tidewater is that it is to be built with much more favorable grades than its pioneer competitor, the Central Pacific line of the Southern Pacific. The company has had the advantage of the experience of the other transcontinental lines and it is believed that the route chosen will never need to be altered by cut-offs or reduction in grades and curvature. In order to obtain favorable grades it has been necessary to sacrifice directness. The Western Pacific is to be 930 miles long between Oakland and Salt Lake City against 781 miles for the Central Pacific between Oakland and Ogden. The Central Pacific, however, passes through more than 40 miles of snow sheds. The Western Pacific will not require any. The Central Pacific has a maximum grade of 105 ft. to the mile westbound and 116 ft. eastbound across the Sierra Nevadas. Besides this summit, it has grades of 75 ft. to the mile east and westbound between Lucin, Utah, and Wells, Nev., across the Pequop range, and a 79-ft. grade eastbound between Rocklin, Cal., and Sacramento. Beckwith Pass, through which the Western Pacific is to cross the Sierra Nevadas, is about 1,900 ft. lower than the Central Pacific summit, and the Western Pacific's maximum grade here and over the rest of its line as well will be 1 per cent., or 52.8 to the mile. The accompanying profile shows in detail the gradients of the new line. It makes clear the great advantages in operating economy gained by the longer distance.

For the first 215 miles from Oakland there are no important grades, except a short grade of 1 per cent. maximum east and westbound at Altamont, 60 miles east of Oakland. At the middle fork of the Feather river at an elevation of 443 ft. begins a 1 per cent. grade 100 miles long, rising to an elevation of 4,817 ft., followed by a 20-mile 0.4 of 1 per cent. grade, bringing the line to Beckwith Pass, 5,019 ft. above sea level. The descending grade on the other side of the pass is, first, 0.8 of 1 per cent. for 20 miles, then 0.4 of 1 per cent. There are several short 1 per cent. grades between Beckwith Pass and Salt Lake. From the level of the Great Salt Lake desert at the Nevada-Utah state line west to Silver Zone Pass there is a 35-mile 1 per cent. westbound grade. The highest point on the line is at Flower Lake Pass, 5,907 ft. above sea level, in the Pequop mountains, 15 miles west of Silver Zone Pass. The line is level for 48 miles through the Great Salt Lake desert and for 47 miles west of Salt Lake City. In all there are eastbound four 1 per cent. grades, a total of 119 miles long, and westbound five 1 per cent. grades, a total of 66 miles, the rest of the line being of lower gradients or level.



Profile, Oakland, Cal., East to Beckwith Pass; Western Pacific.

Profile from California State Line East to Salt Lake City; Western Pacific.

Pennsylvania Railroad Tunnel Extension Into New York City.*

BY A. J. COUNTY,
Assistant to the Third Vice-President, Pennsylvania Railroad.

It is the experience of transportation corporations as truly as of individuals that a selfish and niggardly policy brings ruin, and that permanent development can be secured, and steady reasonable profits realized only by exercising forethought, making judicious expenditures for the betterment of public transportation facilities and providing for future expansion. The Pennsylvania followed a broad policy in undertaking the responsibility of pioneer in tunneling, for long distance and suburban railroad traffic, the North river, which separates New Jersey from that part of New York City known as the borough of Manhattan, and the East river which separates the latter borough from the borough of Brooklyn and the borough of Queens on Long Island.

The lines of the Pennsylvania have terminated on the west bank of the Hudson river since 1871, when it leased the United New Jersey Railroad & Canal Co., and the same barrier of the North river lies between them and the commercial and financial metropolis of the country, hampering the development and movement of traffic. Men have since 1871 slightly bettered their control over nature, but only last month passengers in crossing the Hudson river, from Jersey City to 23d street, New York, usually a run of about 15 minutes, spent between 50 and 60 minutes in fog and ice, this in ferryboats of the fastest and most powerful type. People are landed only on the fringe of the city, where cross-town streets are narrow, and the street paralleling the wharves is filled with drays and heavy wagons, seriously impeding the movement of over 300,000 persons every day. Again, visit Brooklyn Bridge, or any one of the many ferries of the East river on any business day in the rush hour and see the discomforts and delay of travel experienced by the surging masses to and from Manhattan because nature has interposed another barrier called the East river, which is responsible for this congestion and for the comparatively isolated condition of the residents of Brooklyn, to say nothing of those residing in other parts of Long Island.

An examination of the situation shows that in Manhattan, owing to the side barriers of the East and North rivers, and the difficulty of movement between points in such a small and crowded area, the density of population is about eight times as great as the average density of the six other largest cities of the country. Because of these barriers, and the unfavorable climatic conditions of at least six months in the year, Manhattan, although crowded and expensive, is considered the most desirable place for residence, while the suburban section within the limits of Greater New York, in Brooklyn and Queens jointly, have not even the same density of population as found in other cities. These unfavorable conditions have not, doubtless, and doubtless will not, stop its growth, for the population included within a circle of 19 miles inland radius from the City Hall, Manhattan, was, in 1890, over 3,300,000; in 1900, 4,600,000; in 1905, 5,400,000. The increase in 10 years was 38 per cent.

In 1913 the population of this metropolitan territory will, at this rate, be at least 6,000,000, and in 1920 will be well over 8,000,000, without allowing for the effect of the many schemes of improved transportation now under way.

Let me here illustrate the possibility for growth in Brooklyn and Queens, compared with Manhattan, and with the following cities:

	Population.	Area, square miles.	Density per square miles.
Manhattan Borough	2,174,335	21.93	99,148
Brooklyn Borough	1,404,569	77.62	18,097
Queens Borough	209,686	129.50	1,618
Boston	607,340	42.66	14,237
Chicago	2,050,000	190.50	10,761
St. Louis	750,000	61.50	12,195
Philadelphia	1,500,000	129.50	11,582
Greater Pittsburg	450,000	37.25	12,080
Baltimore	560,000	31.50	17,777
London, England	4,542,725	118.00	38,498

It is impossible to judge the growth of a city by the increase of its transportation facilities alone. It is a well-known fact that in New York the transportation companies operating in and near that city have been unable to increase their facilities for travel in proportion to the number of passengers carried, but there has been a notable response to every additional avenue of transportation and commerce. In 1897 over 490,000,000 passengers were carried on the elevated and surface lines in the borough of Manhattan; in 1906 the elevated, subway and surface lines carried over 1,000,000,000 passengers, an increase of 517,000,000, or more than the entire number of passengers carried in 1897.

A similar enormous increase in travel has occurred across the East river. About fifty years ago the first railroad was built in the southwestern part of Brooklyn. This village community was then about 200 years old and had a population of between 20,000 and 25,000. Now there is a city of 77 square miles, with a population of 1,400,000.

Between Brooklyn and Manhattan the traffic crossing the East river, in 1897, numbered 143,000,000. Of these about 50,000,000, including pedestrians, were carried over the bridge. This traffic developed with great rapidity, for in 1906 a close estimate shows that 295,000,000 persons were carried across the East river. The ferries conveyed about 100,000,000, and the railways on the Brooklyn and Williamsburg bridges carried 195,000,000, pedestrians not included.

Leaving the subject of intra-city travel to consider that carried by the railroads across New York harbor, we find that the railroads on the west bank of the North river in 1896 carried nearly 59,000,000 people; in 1890, over 72,000,000; in 1896, 94,000,000, and in 1906 we may safely estimate the figures to be 140,000,000 people. This is the passenger side only; but how are the necessaries of these people provided for, and how do the commodities from the southern and western states reach them? The freight traffic carried on the lines terminating in New Jersey is floated across New York harbor on the East and North rivers. At least 80 to 100 million tons from the railroads are so carried every year. Such conditions indicate that any additional transportation route must be a distinct advantage to the traveling public and to the residents of New York City and Long Island, especially if it remove the inconvenience and delay of transfers across the East or North rivers.

It must be remembered that the problem of the Pennsylvania Railroad in conveying persons and property directly into New York City is not merely a local necessity, but is largely due to the fact that its road is a great avenue of travel between the West and the South and that city, the metropolis of the country for business and pleasure. This responsibility is a gradual growth since its lease of the United New Jersey Railroad & Canal Co. in 1871, when the number of passengers carried was slightly over 7,000,000, and the tons of freight slightly over 2,000,000, whereas, during the past year, there were carried on the United Railroads of New Jersey division 23,000,000 passengers and 31,000,000 tons of freight.

From authentic figures published in 1896 the Pennsylvania carried 25 per cent. of the passenger traffic over the North river, and out of 140,000,000 passengers now carried it is safe to say that the Pennsylvania must move yearly in its ferryboats about 33,000,000 people in and out of New York, in addition to vehicles and commodities. The facilities must be so arranged as to conveniently transport them in comfort and good order during the rush hours as well as in the hours when traffic is lighter, and in the winter months when the conditions of traffic are such as to cause considerable delay and the taking of extraordinary measures to insure safety of passengers.

The Pennsylvania in seeking improved methods of transportation to and from New York, recognized the fact that, trusting solely to ferry facilities, it would fall short of what is believed the future would require for the greater despatch, comfort and convenience of not 33,000,000 people carried to and from the metropolis each year, but what inside of 20 years will be 50,000,000, also had in mind the isolation of Long Island, and the results to be obtained by bringing it into touch by rail with the rest of the world, and accordingly acquired a controlling interest in the Long Island Railroad. This should give it the largest part of the long-distance traffic, both passenger and freight, from that island. As an estimate of what that may be, let me repeat that Brooklyn alone has a population of about 1,400,000, and will, of course, grow enormously when the island is brought into direct contact by tunnel and improved freight routes with Manhattan and the West and South.

The traffic on the United Railroads of New Jersey division of the Pennsylvania in 34 years had a growth of 203 per cent. in passengers and 1,122 per cent in tonnage. I will state this more concretely by saying that since 1895 the ton mileage on the main line of that division increased 104 per cent., and the passenger mileage 79 per cent. Its traffic density per mile of road is now 15,715,246 ton miles and 5,210,804 passenger miles. The passenger traffic on the Long Island Railroad also grew, within this 10-year period, over 33⅓ per cent., and there has been a like increase in its tonnage. The total tonnage of the two for the past year was over 33,720,000 tons, and it may be estimated that the New York and New England tonnage to be handled across New York harbor for the Pennsylvania lines is in the neighborhood of 16,000,000 tons a year.

The situation, therefore, that would confront the company in the next two decades was one requiring instant attention. The interests of the company, as well as the demands of commerce required liberal provision on the Long Island and New Jersey shores for the freight traffic of the entire metropolitan district, and the carriage of through freight to and from the New England states, as well as the passenger extension into New York City and the establishment of a centrally located passenger station, through which inconvenience and delays would be avoided. Various methods of accomplishing this result had at different times been considered, and at one time centered on a bridge for passenger traffic. On account of the great cost of a bridge, and because all the companies whose railroad lines terminated on the west bank of the North River would

*Abstract of an address before the Wharton School Association, University of Pennsylvania, on Feb. 13, 1907. Published in the Annals of the American Academy of Political and Social Science for March.

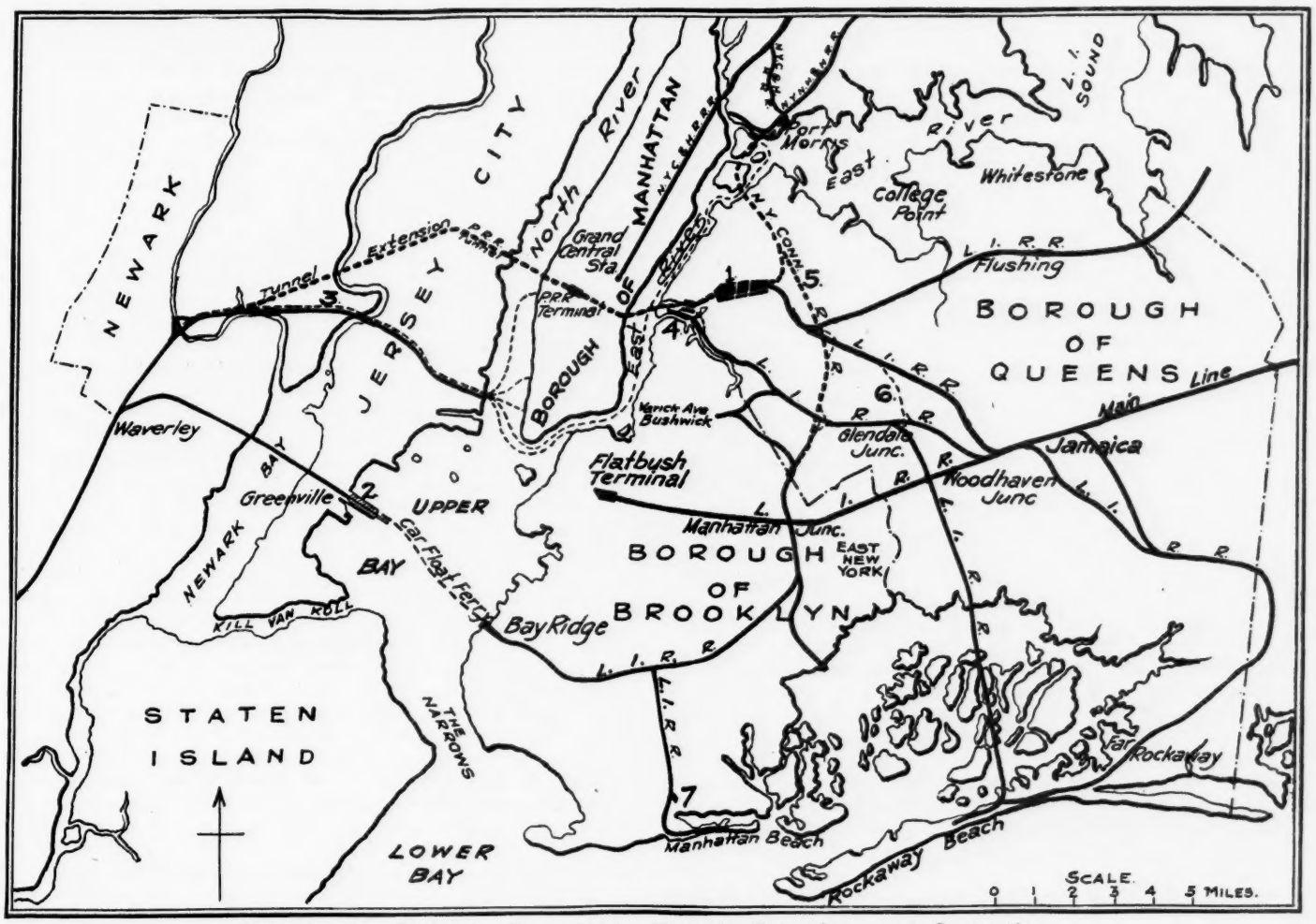
not unite in the undertaking, the bridge was eliminated from consideration. The alternative was the construction of a tunnel line, but the difficulties of steam operation at the depth and with the gradients required by the topographical conditions, seemed to make a tunnel almost, if not quite, impracticable. Meanwhile, however, the successful operation of steam railroad trains in tunnels in other parts of the world by electric power indicated a satisfactory solution of the problem. This undertaking is not an experiment, or a work hastily undertaken. It is the result of many years of deliberate thought and investigation of railroad terminals and tunnels in various parts of the world by engineers of experience and men of executive training. Its practical features have been more than confirmed by the amount of work so far finished, to which I will make further reference.

For many years the company realized that the project was not one that could be financed singly, but necessity eventually became so stern, and growth so great, that the improvements in engineering methods and plans for tunnels were finally regarded as absolutely certain to produce satisfactory results, and such as to justify the company's proceedings alone in its plans for the development of its own system and the movement of its traffic. The tunnel extension has a great advantage over the proposed North river bridge, in that it

Under the franchise the tunnel company must complete its construction within five years and pay the city a compensation per lineal foot for the tunnel tracks, and a further compensation for the use, for station purposes, of the underground portions of the streets, other than 32d, which was vacated and sold to the company, and which it so occupies. Such compensation is fixed for the first period of 25 years, and is subject to readjustment at the end of each like period. For the first period of 25 years it is so adjusted that the tunnel company pays double the amount per annum for the latter 15 years thereof than it does for the first 10, and on this basis the average for the entire period will be about $64,000 a year.

The importance of the project and the engineering questions to be solved in its construction caused the company to create a Board of Engineers, eminent in their profession, to supervise the preparation of all plans and have general direction of the undertaking, reporting to the executives. The work was then divided into three construction sections, the North River division, the East River division and the Meadows division. It consists of about 13.10 miles of new railroad, the part in the open embracing about 7.66 miles and in tunnels about 5.5 miles.

The principal physical features of the work are elevated tracks constructed in the open from a connection with the present main



Pennsylvania Railroad New York Tunnel Extension and Connections.

1. *Sunnyside Yard.*
2. *Greenville Freight Terminal.*
3. *Electrified Line from Newark to Jersey City.*
4. *Newtown Creek Improvements.*
5. *New York Connecting Railroad.*
6. *Glendale Cut-off.*
7. *Sheepshead Bay Terminal.*

provides a direct connection between the lines west of the Hudson river and the Long Island Railroad. It also connects with the proposed New York Connecting Railroad, and through it with the New York, New Haven & Hartford, furnishing a through route between the Western, Southern and New England states.

To carry this tunnel scheme into effect the Pennsylvania, New Jersey & New York Railroad was incorporated on February 13, 1902, in New Jersey, to build from a point near Newark to and under Weehawken and the Hudson river to a point on the boundary line between New Jersey and New York. The Pennsylvania, New York & Long Island was incorporated April 21, 1902. Its western terminus is under the Hudson river on the boundary line between New York and New Jersey, opposite West 31st and West 32d streets. The eastern terminus is at points of connection with the Long Island Railroad, in the borough of Queens. The New York State Board of Railroad Commissioners on November 24, 1902, granted a certificate that such extension was a public convenience and necessity. A franchise from the city of New York was granted by the Board of Rapid Transit Railroad Commissioners on October 9, 1902, accepted by the railroad on November 5 of the same year, and approved by the Board of Aldermen on December 16, 1902.

line, east of Newark, across the Meadows to the portals of the tunnels at Bergen Hill, and a double track tunnel under Bergen Hill, West Hoboken, Weehawken, becoming two single track iron tube tunnels as they pass under the Hudson river into New York to a point near Tenth avenue. When the tracks emerge from the tunnels at that point they begin to increase, and at the terminal station, between Seventh and Eighth avenues, will number 21. At the terminal station site there are about 28 acres enclosed by retaining walls, making a total length of such walls of 7,800 ft. and requiring the excavation of 2,500,000 cu. yds. There will be about 45,000 tons of steel required for the terminal station, and it will have ultimately a maximum capacity for about 1,450 trains, accommodating about 500,000 passengers daily. Within the station area there will be about 16 miles of track.

Easterly from Seventh avenue the terminal tracks finally resolve into four tracks in two twin tunnels extending under 32d and 33d streets to the East river shafts in Manhattan. From the latter point four single track iron tube tunnels extend under the East river and into Long Island and the lines reach the open surface at the entrance to the Sunnyside train yard, where connection will be made with the Long Island Railroad, and later with the New York Connecting

to handle traffic to and from New England, as well as Long Island. The company has been negotiating for the past year for necessary changes in the routes of streets in the Sunnyside yard district on Long Island, and they will doubtless be made so that the construction of the large terminal yard may begin in this undeveloped region. It will, with its approach tracks, cover about 389 acres, and have a capacity for about 1,500 cars.

The plans of the company since their first inception have been materially broadened, as the general recital of the physical features of the extension indicates, and the total cost, including real estate, will probably be not less than $90,000,000, It will be well to bear in mind that the tunnel project is on a much larger scale than the existing facilities. Broadly speaking, it is, after all, only the result of the enormous growth of the traffic of the Pennsylvania for over 30 years, demanding some such provision as now being made for its still greater expansion. Although $90,000,000 seems a large sum, it must be considered that six years will have elapsed between the first and the last expenditures for the work. Therefore, it can readily be seen that if it had been deferred for another decade its cost would have been almost prohibitive, but now it is within the bounds of a reasonable outlay for the results to be accomplished. As proof of this, consider the statement publicly made by a Vice-President of the New York Central, that his company required $70,000,000 for improvement and reconstruction of its station and electrification of its tracks for suburban traffic. It must be remembered that the New York Central is compelled to carry on its large work of improvement within the territory where its tracks are at present located, involving great responsibility because the traffic must continue to move, whereas the Pennsylvania Railroad for its $90,000,000 makes a considerable addition to its system, has a terminal in the central part of New York City with connection to Long Island and New England and a clear field to carry on its work.

By the time the real estate and rights of way had been acquired the management had its plans and specifications prepared by the Board of Engineers, contracts were advertised, awards made to the lowest bidder and the active work of construction undertaken. The work has been steadily pursued until to-day it displays the following evidence:

The masonry work of the several bridges on the line from the connection with the New York division near Harrison, N. J., to the portals of the tunnels at Bergen Hill is making rapid progress toward completion.

The tunnels under Bergen Hill are progressing satisfactorily, the excavation has been made and iron tubes laid for the two tunnels under the North river, and the concrete lining is now being placed. The excavation of the east shore end of these tunnels is now within 200 ft. of the terminal site.

The excavation at the terminal site of the estimated 2,500,000 cu. yds. of material, between Seventh and Eighth avenues and 31st and 33d streets, is almost completed, and a large part of the foundations for the building and sub-surface work in hand.

Eastward from the terminal site to the Manhattan shafts considerably more than one-half of the necessary excavation has been completed, and rapid progress is now being made in the excavation and construction of the four tubes under the East river to the Long Island shafts.

About 75 per cent. of the tunnels east of that shaft has been iron lined, while the excavation is nearing completion, so that with the exception of a short distance in and near the terminal it is possible to walk underground from Bergen Hill, N. J., to and under the East river.

The tunnel extension cannot be considered complete without the following extensive improvements for the development of Long Island and New England traffic which are being undertaken in connection with it:

1. Establishment of the eastern terminus to be called "Sunnyside Yard," between Thompson and Jackson avenues in Queens. This yard is necessary not only for the efficient operation of the tunnel extension in Manhattan, but also for the proper care of the additional traffic which will result from the extension and its interchange with the Long Island Railroad and New York, New Haven & Hartford.

2. Elimination of grade crossings and the electrification of the Long Island Railroad within city limits. These changes improve lines from Flatbush avenue station out to the Brooklyn borough line, and from Long Island City station to Jamaica, and from that station by the Manhattan Beach line through East New York around to the Bay Ridge terminal on the southern shore of Long Island.

3. The Pennsylvania freight terminal yard and piers at Greenville, N. J., connecting by the proposed straight and relatively short ferry across the Upper Bay with the Bay Ridge terminal of the Long Island.

4. Enlargement of handling facilities for freight in Brooklyn and Queens, by establishment of many yards, which are necessary to put these boroughs in touch with the rest of the country by rail and for their local requirements.

5. Completion of what is known as the "Atlantic Avenue Improvement" in Brooklyn, which requires the removal of steam railroad tracks from the surface of that avenue, at the joint expense of the railroad and the city, and a large and very expensive improvement at the sole cost of the railroad, of the passenger and freight station at Flatbush avenue. This point will in the future probably be the most important distributing point for passengers in Brooklyn, the improved station and terminal being designed to occupy sixty-one lots. When the New York Connecting is finished residents of Brooklyn and Queens can travel direct by that route to New England and the North and East, and by way of the Pennsylvania Terminal in Manhattan to the West and South.

6. The New York Connecting Railroad is to be 12 miles long, to run through a part of Queens, then by a bridge across the East river at Ward's and Randall's islands, and will be the connecting link for passenger and freight traffic to New England. It will abolish the largest part of the floatage in New York harbor now carried on by the Pennsylvania by delivering and receiving freight at Bay Ridge, Long Island, and will carry all the passenger traffic through the Pennsylvania Railroad tunnels.

7. Construction of the Glendale cut-off between the main line, Montauk division and Rockaway Beach division of the Long Island. This is necessary for the improved passenger service and to give direct connection with the Pennsylvania tunnels.

8. New piers and docks on Newtown creek at its confluence with the East river for traffic to and from the Long Island Railroad.

9. Electrification of United Railroads of New Jersey division from Newark into Jersey City for local passenger traffic.

The accompanying map shows the vast improvements contemplated and their tremendous possibilities to the Pennsylvania System of Greater New York, and, in fact, the entire country.

Summing up, the Pennsylvania's New York Tunnel Extension is a line of railroad from Newark, N. J., to Port Morris, N. Y., through Manhattan and Queens. Reasons for its construction were:

To provide for the future by enlarging the present facilities for freight and passenger traffic, because of its continuous growth, and to accomplish it before the cost became almost prohibitive, or the task impossible because of the construction of other underground transportation lines.

To run passenger trains into a central location in New York instead of to a station on the west bank of the Hudson river.

To open to the people in the thickly populated borough of Manhattan the residential sections of Long Island, and to offer to Newark and other populous towns in New Jersey direct and quick access to the resorts on Long Island beaches.

To provide a better highway for railroad traffic to New England by shortening the water trip across New York harbor from 12 to 3¾ miles.

To give Brooklyn and Queens, with their population of over 1,500,000, direct railroad connection to and from New England, southern and western states, and to supply freight facilities with similar connections in these boroughs, thereby properly serving the entire area of Greater New York through freight stations, suitably located to develop its commercial interests.

To make its Long Island Railroad investment remunerative within a comparatively short period.

To obtain a proper share of the golden future by judicious expenditures in a territory having abundant promise, whether viewed from the growth of traffic in the past or the outlook for the future.

Dedication of the Engineering Societies' Building.

The new building of the United Engineering Societies on West 39th street, New York City, which was presented as a permanent home to the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the Engineers' Club by Andrew Carnegie, will be formally dedicated on April 16. The dedication services will be held at 3 p.m., Charles Wallace Hunt presiding, and will include an historical address by Charles F. Scott, chairman of the conference and building committees; an address by Andrew Carnegie, and an oration by President Arthur T. Hadley, of Yale University, on "The Professional Ideals of the Twentieth Century." In the evening a general reception will be held in the main auditorium.

On February 14, 1903, Mr. Carnegie offered to give to the three societies and to the Engineers' Club $1,000,000 to provide a suitable home for them all. This was increased a month later to $1,500,000, after it had been found that an adequate building could not be erected with the sum originally named. The only limitation on the gift was that it should be devoted to the erection of a building, the bodies interested buying the land. It was decided to erect two separate buildings, one for the club on 40th street and one for the three professional societies on 39th street, the two buildings to be placed in such relationship that access from one to the other would be easy.

The frontage of the Engineering Societies building on West 39th street is 115 ft. and the depth is 90 ft. It is designed in the French style and rises 13½ stories above the sidewalk to a height

of 218 ft. 6½ in. The exterior is built of limestone up to the auditorium floor, and of gray mottled brick and terra cotta above. As the lower portion is devoted to auditoriums, the middle section to offices, and the upper part to the library, an effort has been made to accentuate these three separate parts of the building, with happy result.

Access to the building is gained by the central entrance on the street level to the first floor, by the western side door leading to the elevators, and by the broad driveway which encircles it completely, so that carriages can enter by the eastern covered arch, set down their occupants at a side entrance and emerge by the western gate. There are three elevator riseways in the main elevator shaft, faced with an iron grill lined with wire glass. On each side of this shaft wide stairways rise to the sixth floor of the building, and one leads thence to the library floor. A freight elevator has been installed on the eastern side of the building, and a commodious service stairway on the north side rises the entire height of the edifice. At the first floor a rear door communicates across the 10-ft. areaway, in the open, with the café of the clubhouse, and on the ninth floor a flying covered bridge connects with the breakfast room on the tenth floor of the club.

The first floor is laid with Tennessee marble tile, having a border in design of colored marble. The central part or main foyer is marked by twelve large columns of Swiss Cipolin marble. A short low flight of steps leads from the foyer to the elevators. The wood work is in dark oak. Large chairs and lounges in red leather furnish the foyer, and similar furniture is used in the writing-room, smoking-room, reception-room and administration-room, which also contains three telephone booths connected with the "private exchange" system. On the foyer walls, facing toward the main entrance, are two large bronze tablets, one bearing a relief portrait of Mr. Carnegie and the words of his second terse letter of gift of $1,500,000, and the other a statement to the effect that the land was given by members and friends of the three founder societies. On this floor also, at the rear, are receiving and shipping offices, through which all freight and goods are handled.

Immediately above the first floor is the coat room, laid out on a sectional plan, so that several lines of persons may be accommodated at once on entering or leaving. Special toilet facilities are also provided on this floor, which virtually occupies the space that would otherwise be left blank by the slope of the main auditorium floor just above it.

The main auditorium extends up through two floors, and with its gallery will seat about 1,000 persons. This chamber had to be arranged primarily for the general meetings of the societies, at which the speaking is from the floor as well as from the platform, and at which diagrams, illustrations or blackboard drawings are often employed. This is quite the opposite from the ordinary audience hall, where the stage is the starting point both for the seating arrangements and for the acoustic and optical necessities. Hence the platform is notably small for so large a hall, accommodating few persons, while any speaker in the audience is easily within range of observation by everybody.

On both the parterre and the gallery floor, at the sides, the auditorium is surrounded by corridors, rendering access to every point very easy, and permitting ready withdrawal for conversation, committees, etc. The corridors assist also in maintaining quiet within the hall. The platform has ante-rooms and is conveniently close to the freight elevator for delivery of apparatus. There is also a fine stereopticon equipped with connections for moving pictures. The seats are fixed opera chairs in red leather with revolvable tops, and the aisles are laid with red carpet. The gallery front is bordered in red plush. Above the auditorium arch is a decorative cartouche bearing the badges of the three founder societies. There are side brackets for lighting, but the main illumination is effected indirectly through the glass ceiling, above which are incandescent lamps controlled from several panel boards. The elevators and stairs open directly upon the two floors of the auditorium, which can thus be emptied very quickly in case of emergency. Practical tests of the chamber have already shown it to be a success in every respect of comfort and convenience.

The next two floors above the main auditorium are devoted entirely to lecture-rooms, of which there are no fewer than seven. Two spacious assembly rooms, 51 ft. by 66 ft. and 29 ft. by 66 ft., occupy the larger part of the fifth floor in such a manner that they can be used independently, or one may be made auxiliary to the other. Two smaller rooms on this floor, 16 by 22 ft. and 18 by 19 ft., can be also used separately, or as annexes for reception purposes, and provision is made with steam tables, etc., for the service necessary for luncheons or light refreshments. All these rooms are agreeably finished in soft light tints and have facilities for water, air, electric connection, etc., for demonstrations and experiments.

The sixth floor is also divided into lecture-rooms, planned somewhat differently, and of smaller dimensions than those on the floor below. The dimensions are, respectively, 22 by 44 ft. 6 in., 30 by 46 ft. 6 in., 30 by 41 ft. and 20 by 28 ft. In this manner the building affords facilities to audiences of every size from 1,000 down to 100, while on occasion every room can be occupied by sections and subdivisions of an engineering or scientific meeting, with independence and without interference.

The seventh and eighth floors of the building have been reserved for the Associate Societies that have engineering or some department of science as their principal object. For these organizations the building affords office areas of varying size, from one room up, with the common facilities of the lecture-rooms, library and other accessories. Among these societies may be enumerated the Society of Naval Architects and Marine Engineers, the Society of Heating and Ventilating Engineers, the National Electric Light Association, the Society of Chemical Engineers, the New York Electrical Society, the Association of Edison Illuminating Companies, the American Street and Interurban Railway Association.

Each of the three founder societies occupies a floor laid out in accordance with its own plans. The American Institute of Mining Engineers has the ninth floor, the American Institute of Electrical Engineers has the tenth floor, and the American Society of Mechanical Engineers has the eleventh floor. These floors are all devoted to administrative and executive work, and the libraries of the three societies have been concentrated in the two top floors of the building.

A crowning detail in the plan of the building has been the reservation of the twelfth and thirteenth floors for the libraries of the three founder societies and of such other collections of engineering literature as may be added. The twelfth floor below the library proper has been devoted to the book stacks, but at the present time the main library is also equipped with one tier of stacks, with provision for a gallery tier later. The stack-room is partly equipped with stacks, and in the library a delivery desk, reading tables and chairs have been provided. The founder societies entertain the ambition of creating and maintaining the finest collection of engineering literature in the world, supplemented by the current periodicals, and all the patents relating to invention in the art and sciences. Provision is being made for special research accommodation, working alcoves, photographic reproduction, drawing and similar library work. The library is retired, quiet, free from noise and dust, and will be open at all times to any reader.

Decision by Judge Speer on the Federal Employers' Liability Act.

The constitutionality of the law passed by Congress last June, enlarging the liability of common carriers for damages in case of injury to employees—which has been decided by two United States Judges in one way and by two others in another way, and which is soon to come before the Supreme Court of the United States—is the subject of a somewhat exhaustive decision by Judge Emory Speer, of the United States Circuit Court for the Southern district of Georgia, which has just been published. This case is that of Snead against the Central of Georgia, which is a suit for damages for the death of a bridgeman who was knocked off the bridge to the ground below by the negligence of other employees. Judge Speer holds the law constitutional. The Judge says that he is aware that nothing short of a decision by the Supreme Court will be generally satisfactory, but he did not feel at liberty to evade the responsibility of making his own determination. Even if he were in doubt as to the constitutionality of the law he would uphold it, for "it is a part of that splendid practical philosophy of government which is intended for the betterment of mankind." The syllabus of the decision says:

The final and common arbiter of all constitutional questions is the supreme judicial authority of the courts of the United States. There is a settled presumption in favor of the validity of every legislative act. Every reasonable judicial doubt must be resolved in favor of the law. The courts will decide that Congress has transcended its powers only when that is so plain that they cannot avoid the duty. Employees of corporations engaged therein are instrumentalities of commerce. Restrictive or benevolent regulation of those employees is within the power of Congress, which may be exercised to its utmost extent, and acknowledges no limitations other than those prescribed in the Constitution. Congress alone by legislation may occupy the whole field of interstate commerce. The words "to regulate" import the right and power to *enact laws*, and not merely to make rules and regulations. When a corporation engages in interstate or foreign commerce the men who control it, and the corps of its employees, become subject to all those legitimate means which Congress may select for its regulation. The reasons now alleged for the rule denying to an employee the right to recover for injuries sustained by the negligence of a fellow-servant, in view of modern conditions, are archaic. The purpose of Congress being legitimate, and expressly relating to employees engaged in interstate or foreign commerce, it is immaterial to the validity of the act that somewhere in its operation it may have a casual or contingent effect upon the domain of state legislation. The Government of the United States, within the scope of its powers, operates upon every foot of territory in its jurisdiction. It legislates for the whole na-

tion, and is not embarrassed by state lines. Here, however, no right proper to the state, or any of its instrumentalities of government, is drawn in question. * * *

The main arguments of the defendant were that the act is not a regulation of commerce within the meaning of the commerce clause of the Constitution; that said act, if it be a regulation of commerce, is not limited to commerce with foreign nations, or among the several states or with the Indian tribes, but extends as well to intrastate commerce; that interstate and intrastate employees are so commingled by this act that it is impossible to make it apply only to interstate employees, unless the court reads into the act something which Congress has not put there, and this the court may not do; that it is a violation of the fifth amendment to the Constitution, which provides that "no person shall be deprived of life, liberty or property, without due process of law."

On the claim that a man engaged in interstate traffic may also handle traffic which is intrastate, and that this should vitiate the legislation of Congress, Judge Speer says that by parity of reasoning this would annul the federal laws which regulate interior waterway nevigation, and would abolish the Interstate Commerce Commission. Were the argument sound, "the shipment of a crate of pigs from Macon to Griswoldville would annul the power of Congress to control the shipment by the same train of a thousand bales of cotton bound from Macon to Liverpool." In the trade mark cases, and others relied on by the defendant, the laws in question contained no reference to interstate or foreign commerce, while the law now in question is clearly declared to be a regulation of interstate commerce.

President Joline on the Railroad Situation.

The following are extracts from the speech of President Adrian H. Joline, of the Missouri, Kansas & Texas, at the annual meeting at Parsons, Kan., on April 4:

In spite of our prosperity we are troubled. I do not mean that we are troubled by the contortions of the stock market. There is no stock ticker in the offices of the M., K. & T. This road is run to serve the public well and thereby to serve its owners well—not to enable some so-called Napoleon of finance to amass a colossal fortune.

The Missouri, Kansas & Texas has produced no plutocrats, as far as I know its history. No one connected with it has ever been guilty of enormously increasing the output of stock and bonds in order to lure an innocent public into incautious investment.

Credit is the cornerstone and foundation of all business; and when you have the cruel and unthinking hammer of the labor unions striking you on the one side and the reckless and unprincipled hammer of the political demagogue striking you even more mercilessly on the other, what becomes of your credit?

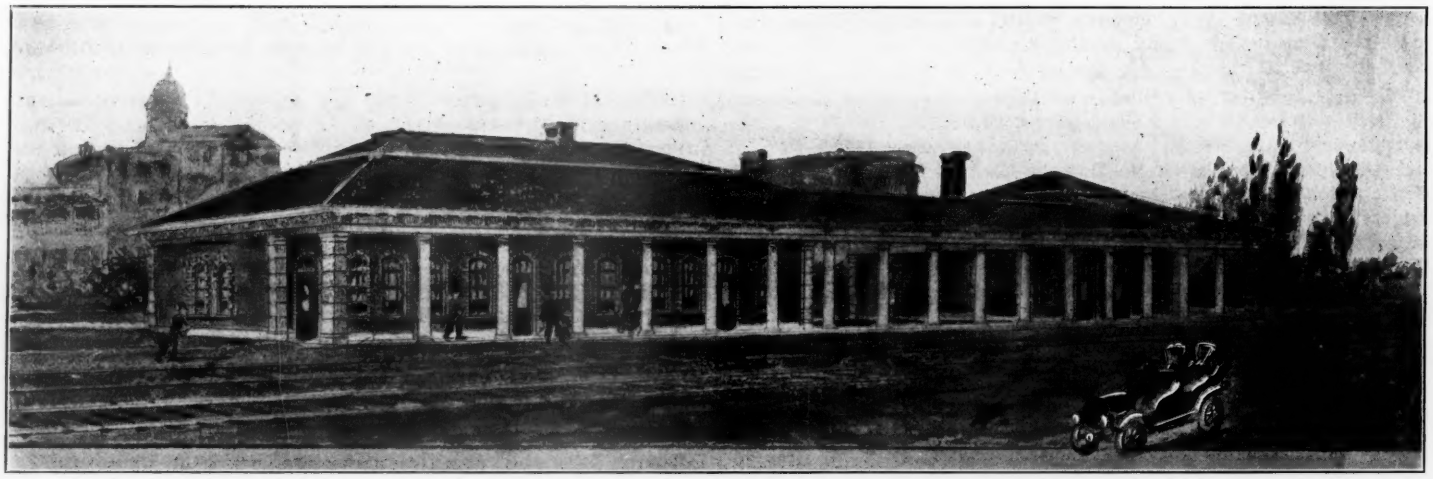
We hear a great deal about "co-operating with the government." I am unable to find in the constitution or the laws any provisions which affect or regulate co-operation between the government and the private citizens who carry on their business under the laws. The only way to co-operate with a government is to try to obey the law—however silly the law may be—to obey it not only in the letter, but in the spirit, as well as a law can be obeyed when you consider that you are obliged to trust to many thousands of agents of varying and often limited capacity, who have most of the infirmities of man. No doubt under government ownership with politicians in charge of our roads the operation of our lines would be ideal; there would never be any accidents, any man who wanted a car could have it just when and where he wanted it, and keep it as long as he wanted to; every one could have a train start at his favorite time and stop whenever he wanted to get off; every one could have his own particular freight carried to just the place where it was intended for and delivered at the moment, without reference to any conditions of weather, track or traffic, and as a result large dividends would be paid to the public out of the public's own pocket. Our experience with the operation of government conducted enterprises, here and in foreign countries, tells us that it would all be as I have said.

I am obliged to take issue with William J. Bryan on the proposition that the public has shown no disposition to reduce railroad earnings to a point which would deny a reasonable return. The public, at least so far as it is represented in the legislatures, has shown exactly that disposition, and as long ago as the Granger agitation it was necessary to invoke the aid of the Supreme Court of the United States in order to check that very disposition. The recent enactment of laws restricting the passenger rate to two cents a mile, without regard to any conditions either as to territory or population, making the same rate for the crowded states of Ohio and Pennsylvania and the sparsely settled states of the West, testify to this disposition.

It will be the policy of this company, so far as I may have anything to do with it, to resist by all reasonable and legitimate methods the enactment of laws which are unjust and unfair; to bring them, if enacted, before the courts for construction and for determination as to their validity and constitutionality, but to obey them honestly and faithfully, if they are ultimately declared to be valid, even if it leads to insolvency and a receiver. It is useless to resort to petty methods of retaliation; they are only irritating and impotent. We may as well make up our minds that if the people of this country have made up their minds to destroy our property and the courts have decided that they have the right to do so, we must submit. But I cannot believe that in any country which calls itself free and enlightened such a thing can ever come to pass.

New Southern Pacific Station at Oakland.

The Southern Pacific is to shortly begin building a new passenger station for its local trains and some of its main line trains at Oakland, Cal. The site is on the city block bounded by Broadway, Franklin, First and Second streets. The main front of the station will be parallel with the main line tracks on First street. From the opposite side of the building roadways for passengers and teams will run north to Second street. The station will be 194 ft. x 60 ft., and will consist of a waiting room and ticket office near the southwest corner of First street and Broadway with an arcade extending along First street the whole length of the block to the baggage room at Franklin street. This is to be in a separate building 55 ft. away. The arcade is to be 14 ft. wide with reinforced concrete columns and a cement wall. The columns are to have cast cement caps, and the roof of the arcade is to be of slate. The waiting room is to be 92 ft. long and to have dark red stock brick walls. A large fireplace with a mantel decorated in bas relief will be an important feature of the general effect. The room is to have tile floors and wainscots. The ornamentation around all door and window openings is to be of quoined cemented brick work; the truss roof will be covered with slate and have a galvanized iron or tin deck. The baggage room is of the same general construction and exterior decoration. It is to have a bitumen floor and cast-iron cornices. The station grounds will be parked, planted with semi-tropical flowers and trees and surrounded by cement walks.



Southern Pacific Passenger Station to be Built at Oakland, California.

Recent specifications for new locomotives for the Prussian State Railroads require that provision be made in the cab for heating food for the enginemen when compelled to eat away from home.

Track Deformations and Their Prevention.*†

BY G. CUENOT,
Government Engineer of Bridges and Highways, and connected with the Board of Control of the Paris, Lyons & Mediterranean Railway.

V.

DEFORMATION OF THE TRACK.

The sliding of the track, which is one of the most frequent deformations, and the most prejudicial to operation, is not, however, the principal one; others are produced, by the processes of continual operation so to speak, which cause disorders in the track. While not primarily as grave, they occasion by their repetition serious difficulties. Among them may be mentioned creeping of the track, narrowing of the gage on tangents, or its spreading on curves; the compression of the wood at the supports, tearing out the screw spikes, and, finally, the shock which is produced right at the joint, and which causes the dislocation of the track and the vertical deformation of the rail.

All these deformations are caused by the longitudinal and transverse movements previously described. They are the consequences of them, to such a point that when these movements are diminished, the deformations are reduced at the same time.

(1) CREEPING OF THE TRACK.

Rolling loads produce, in the direction of the movement of the trains, longitudinal displacements of the rails, which are ordinarily called dragging or creeping, and sometimes the entire track is drawn along. The ordinary methods employed for preventing creeping (notching of rails, anti-creepers, joint plates, angle bars) transmit, in a certain measure, the forces producing the longitudinal pushing of the rail to the fastenings as well as to the tie and to the ballast. The movement is more or less retarded, and the advance, whose effects are injurious, as I will show further along, diminished.

The rails are subjected in the longitudinal direction to two forces in a contrary direction; the driving wheels of the engine determine by their adhesion a reaction on the rails directed in an inverse direction to the travel; the carrying wheels of the engine and those of the other vehicles tend on the contrary to push the rail ahead. It is the last effects which are predominant, and experience shows that the longitudinal movement of rails always takes place in the direction of the trains on a double-track line.

But the longitudinal movement is not equal in the two lines of rail, even on tangents; when the road is double track the rail advances more rapidly in the line of rail on the outside (the left line) than in that of the inter-track side (right line).

It results that the joints of the two lines of rail are no longer concordant; ties, especially those which act jointly with the rail, for example, the ties of the even-joint at the following end, are no longer placed normally with the track; the gage of the track narrows; the screw spikes lose their contact with the base of the rail. The overlapping of the joints, which in general are low, no longer allows the fall of the wheels at the passage of the joint to be simultaneous on the two lines of rails, and there must necessarily result from it zig-zagging movements for the engine and cars.

The longitudinal dragging causes as an effect the allowance for expansion at the joints to disappear when the temperature rises, the rails, no longer being able to expand, become compressed, and a zig-zagging movement can produce a lateral sliding of the track.

It is necessary, periodically, to put the rails back in place, and this operation is costly; Mr. Ferry estimates it at $18.80 per mile per year on a line of average traffic. The longitudinal movement is therefore of real importance, and the principal causes which determine this forward movement should be sought.

Mr. Coüard estimates that the creeping (*Revue des Chemins de Fer*, August, 1896) ought to be attributed principally to the shock of the wheels at the passage of joints. It will be seen, further along, that the rails deflect at their extremities at the passage of the wheels, and that the latter fall from each rail on the following-rail, always more or less inflected, and produce a shock the more perceptible, the older the track is and the more deformed the rails are vertically. The wheel would act on the following-rail after the manner of a wedge, and would drive it before it.

This explanation of the advance movement is very proper, and is corroborated by a series of facts which Mr. Coüard has put in evidence in a very neat manner.

Thus, the speed of the trains increases the dragging; the latter is therefore maximum on the grades. Braking produces the same effect, since sliding friction is added, and creeping is very pronounced at the limits of stations.

On curves this movement is accentuated, especially on the line of rail of short radius, since the latter receives a larger part of the load by reason of the inclination calculated for the highest speeds, and since the sliding friction of the tire against the rail acts in the direction of movement. On the line of rail of long radius the movement has a tendency, on the contrary, to be produced in an inverse direction, in consequence of the cutting of the rail by the flange of the engine. This effect is diminished by the employment of the bogie truck, which enters the curves better. On a right alinement, the dragging is produced most thoroughly on the outside line of rail, in consequence of the unequal subsidence of the ties, a subsidence which consequently produces a greater loading on that side of the track. When the line of rail of the short radius is found at the same time on the outside, the two movements are conjoined and the dragging is greater.

The ballast acts equally either for increasing or diminishing the importance of the movement. Mr. Ferry has proved an advance of ⅝ in. per thousand trains on track laid in a very variable ballast, that is to say, deprived of all residue by sifting, and freshly placed.

But the explanation given by Mr. Coüard has not been admitted by all the technicists; the shock which is produced by the passage of wheels from rail to rail doubtless has an influence, since the simple substitution of angle bars for fish-plates has diminished the creeping, but it ought to have other secondary causes, which act in the same direction, and which complicate the study of the phenomena. Thus Professor Johnson, at St. Louis, attributed the creeping of rails to the undulatory movement studied above, which is produced in consequence of the oscillation of the supports.

The resistance, which the friction between the rail and the tie opposes to the return of the points of rest of the rail on its supports, gives consequently a slow creeping of the rail in comparison with the ties.

The shock and the undulatory movement exercise a very serious action on the creeping; they are not, perhaps, the only elements susceptible of producing it. It has been seen, in fact, that, on a line of two tracks, each of which is only traversed by trains going in the one direction, the dragging of the rail is more sensible on the exterior side, that is to say, on the outside space. Mr. Coüard thought that this fact was due to the unequal subsidence of the ties, which tend to incline to the side where the ballast and roadbed present the least resistance. This explanation does not suffice, since the same anomaly is observed on lines with four tracks; it is always the left line of rail in the direction of movement which is submitted to the strongest dragging force. Other explanations have been sought, such as the lack of symmetry of the engine, which would be more heavily loaded on the left, the position of Giffard, etc.; it suffices to cite them, in order not to retain any of them, for they do not rest on any precise observation.

The question then remains intact, and has not been entirely solved, in spite of all the interest which it presents; but it is necessary to retain the influence of the shock and of the undulatory movement, whose effect is of great importance, especially that of shock, as I have shown.

The author will endeavor to show, in the second part of this work, the methods employed for combatting the creeping, and to indicate those which should be adopted to arrive at a better result.

(2) REDUCTION OF THE GAGE OF THE TRACK ON TANGENT AND THE WIDENING ON CURVES.

Mr. Coüard has pointed out, in very precise experiments, of which he has given an account in the *Revue des Chemins de Fer* for July, 1888, that in right alinement the rails are inclined to the interior of the track, and that on curved alinement the same movement takes place to the outside. He has equally proved that at the joint the rail in advance is inclined more than the following rail, and that the wheel falls from the first on the second.

The mean inclination on right alinement is as follows: With a good tamping of the tie, .067 in. on the advance rail, and .028 in. on the following rail (line of rail on the outside).

With a defective tamping, .08 in. on the advance rail and .04 in. on the following rail (line of rail on the outside). The line of rail on the outside should incline more than the line of rail of the inter-track space. The consequence of the unequal inclination of the two rails, advance and following, is to super-elevate the advance rail in comparison with the following rail, to provoke a fall of the vehicle, which withdraws considerable length of the following rail from contact with the wheels, and which increases at the same time as the inclination.

Mr. Coüard considers that this inclination would produce the same effect as if the rail were pivoted about the interior edge of its base. He has established that the jerk which is felt at the passage of joints cannot be attributed to the space left between the two rails for expansion, but to the unequal level produced by the unequal rotation of the two extremities of the rails. "The shock brings about, little by little, the unpacking of the tie at the following end of the even-joint, and the latter circumstance augments still more the jerking at the passage of the joint, the lowering of the following tie tending to increase the unequal level of the two rails."

On a curve, the first axle of the train is that which most deforms the track. The line of rail on the side of the short radius is projected towards the center of the curve; the line of rail on the side of the long radius is, on the contrary, inclined to the interior

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†Authorized translation by W. C. Cushing, M.A., B.S., Chief Engineer of Maintenance of Way, Pennsylvania Lines West, Southwest System.

of the track; the first axle only produces an inclination to the exterior.

Mr. Coüard has analyzed intelligently the phenomena of narrowing and widening of the gage of the track, but he has not perhaps given the exact reasons. If he has indeed seen that the widening of the track ought to be attributed to an exaggerated super-elevation given to the rail of long radius on curves, it does not seem that he has found the reason for the reduction of the gage of the track, which is produced on tangents.

I have shown, by numerous experiments, that the wood tie employed on railroads, bends in a very perceptible manner. The rail tends then, in consequence of this flexure, to be inclined towards the interior of the track, and this effect is again augmented by the compression of the supports and their deformation on the interior side, as we shall see further along, since the inclination of one-twentieth given to the rail, and the flexure of the tie, act in the same direction, and bring the weight of the load towards the interior. The unequal inclination of the two rails is also a consequence of the flexure, since the tie at the advance end of the even joint undergoes the maximum flexure and draws over the rail, while the tie of the following end of the even joint has not yet attained its complete deformation, and the imperfect splicing does not induce the two rails to act at the same time.

Besides, Mr. Coüard has implicitly recognized the causes given above, since he has proved that the placing of plates under the rails, distributing the load over a greater surface, diminishes the effect of the reduction of the gage.

(3) COMPRESSION OF THE TIES RIGHT AT THE SUPPORTS.

The rails are fixed on the ties, whether it be directly or indirectly, by means of plates of support; in the first, as in the second case, but especially in the first, the wood is compressed excessively, and finishes by taking a permanent deformation.

In the bending tests of ties the lowering of the rail has been marked, apart from the points taken on the tie. This lowering, which has always been found in excess of that of the neighboring points, gives the measure of the sinking of the rail on its support, and, consequently, of the compression of the wood. In order to appreciate its value, mean figures of the lowering of the points of the tie, situated on each side of the rail, have been taken, and the difference between these figures and those of the lowering of the rail have been given. The table below, which sums up these calculations, brings out the fact that the sinking of the rail in its support is about twice as great with ordinary ties as with composite ties:

COMPRESSION OF SUPPORTS AND INCLINATION OF RAIL.

No. of ties.	Figures for points observed to the right and left of the rail. 2.	3.	Mean figures. 4.	Figures for the rail. 5.	Diff. bet. the figures of cols. 4 and 5. 6.
	1. *Wooden Ties (P. M. rails)—Line of long radius.*				
5	14.5	20.0	17.2	18.0	0.8
6	25.0	19.5	22.2	26.0	3.8
7	15.0	21.0	18.0	20.5	2.5
20	13.0	19.0	16.0	17.5	1.5
	Mean compression				2.1
	Line of Short Radius.				
5	24.0	21.0	22.5	26.0	3.5
6	22.0	23.5	22.7	26.0	3.3
7	27.0	24.0	25.5	29.5	4.0
20	25.5	21.0	23.2	27.0	3.8
	Mean compression				3.6
	2. *Composite Ties (P. M. rails)—Line of long radius.*				
7A	23.0	22.5	22.7	23.5	0.8
7B	22.0	23.0	22.5	23.0	0.5
9	12.0	14.5	13.2	15.5	2.3
10	19.5	19.5	19.5	21.0	1.5
11	25.5	26.5	26.0	....	...
12	11.0	12.0	11.5	13.3	1.8
15	12.0	14.5	13.2	13.5	0.3
15	11.0	14.0	12.5	13.5	1.0
16	9.5	10.5	10.0	10.5	0.5
18	19.0	19.5	19.2	19.5	0.3
19	15.5	13.5	13.5	15.5	2.0
	Mean compression				1.1
	Line of Short Radius.				
7A	32.5	37.5	35.0	35.0	...
7B	33.0	33.0	33.0	36.5	3.5
9	19.5	16.0	17.7	23.0	5.3
10	24.0	24.0	24.0	29.0	5.0
11	23.5	24.0	23.7	27.5	3.8
12	19.0	17.0	18.0	19.0	1.0
13	21.0	22.0	21.5	27.5	6.0
14	23.0	24.5	23.7	25.5	1.8
15	17.0	19.5	18.2	21.0	2.8
16	19.5	20.0	19.7	23.0	3.3
17	15.0	14.0	14.5	16.5	2.0
18	23.5	26.0	24.7	26.0	1.3
19	20.0	20.0	20.0	21.0	1.0
	Mean compression				2.8

3. *Recapitulation.*

Wooden ties—line of long radius.	2.1	Wooden ties—line of short radius.	3.6
Comp. ties—line of long radius.	1.1	Comp. ties—line of short radius.	2.8
Difference in favor of Comp. tie.	1.0	Difference in favor of Comp. tie.	0.8

NOTE.—The figures are expressed in tenths of millimeters.

It is, however, necessary to remark that this reduced sinking is not due entirely to the reduced compression of the wood, but that, apart from this fact, it is also necessary to take account of the flexure of the tie, which increases the compression under the base at the inside edge of the rail, already greater by reason of the inclination of 1 in 20. But this flexure increases but little the effect of the sinking, for the slope of the bent tie scarcely reaches 1 in 400, a negligible quantity in comparison with the inclination.

Whatever the reason may be, the compression of the wood is produced, and it is a maximum on the interior side, because, for the reasons given, the loads are carried on this side. This coincides with the statement of Mr. Coüard, set forth in his article for July, 1888, in the *Revue des Chemins de Fer;* he has claimed correctly that the rail turns about its interior edge, which produces a super-elevation of the advance rail in comparison with the following rail, and determines a drop at the passage of the joint.

The increases of the resistance of ties to compression presents very great interest, and is intimately connected with the question which now occupies us, that is to say, the attempt to find out how to avoid deformations, in order to obtain a better circulation of traffic, and realize more considerable speeds. After the passage of trains, the rail returns to its primitive position; the base reacts on the head of the screw spike, tending to tear it from its socket.

(4) PULLING OUT SCREW SPIKES.

The sinking of the rail in its support, the least bending of the tie, and the elastic reaction which results from it, exercise, slowly but surely, pulling effects on the screw spikes. At the end of a certain time, the screw spikes, which unite the rail with the ties, no longer hold, especially those which on a tangent are located in the interior of the track. They can be readily pulled out of their holes.

That is why a study of the fastenings is necessary; it is necessary to know the limiting force which can be applied to the screw spikes before they can be withdrawn, and that which they can support before a spreading of the track .98 in. takes place, considered as sufficient to put it out of service; finally, the limiting force which can be imposed on it before obtaining excessive turning.

These experiments have been executed with two very ingenious pieces of apparatus devised by Mr. Albert Collet, and which he has named the *extrahomètre* and the *déclimètre.* They have been used, as will be seen later, on ordinary and composite ties, with or without treenails, of which Mr. Collet is the inventor.

(A) EXPERIMENTS WITH THE EXTRAHOMETER.

The *extrahomètr* is a very small testing apparatus, with register and with means for measurement, weighing only 13.23 lbs. and able to support a force of 8.82 net tons which is exercised vertically on the head of the screw spike, in the manner for extracting. This force is produced up to the moment when the wood is torn and yields; at that moment there is no more resistance in consequence of more force.

This apparatus (Fig. 13), entirely of steel, is composed of a square pedestal, S, serving as point of support, through the opening of which is introduced the head of the screw spike, which is engaged in the foot of the dog, G. The foot of the dog is in one piece with the traction cheeks, F, and the nut, D, in which travels the motor screw, V, directed at R, by the key for screw spikes. Between the two cheeks is a cylinder, C, whose two flanges, N, rest on the pedestal. The cylinder contains liquid glycerine in T, and above, a piston, P, packed with leather, carrying a small ball, L.

At the extremity of one of the flanges, N, a pressure gage receives and records the pressure exercised on the liquid passing by the capillary conduit, M. B is a release latch, and E a symmetrical arrangement allowing the adoption of a standard, in order to verify the pressure gage in case of necessity. The travel of the foot of the dog is 1.57 in. This apparatus is in use by several railroad companies in France.

The table which follows gives the results obtained on composite ties:

COMPOSITE CROSS TIES.

Without treenails: Forces on screw spikes of the Middle wedges.	Lateral wedges.	Raise of middle wedges.	With treenails: Forces on screw spikes of the Middle wedges.	Lateral wedges.	Raise of the middle wedges.
13,228 lbs.	.....	0.04 in.	15,873 lbs.	15,983 lbs.	0 in.*
12,235 "†	.....	0.02 "	15,983 lbs.	.....	0 "
12,787 "	13,228 lbs.	0.0 "‡	.....	.....	..
11,464 "	11,574 "	0.0 "‡	.....	.....	..
13,228 "	13,007 "	0.0 "‡	.....	.....	..
11,023 "	12,787 "	0.0 "§	.....	.....	..

Observations:
*Wooden wedges of creosoted oak, but split by frost.
†This wedge was split before the trial.
‡Mean force:—Middle wedge without treenail, 12,324 lbs.; lateral wedge, without treenail, 12,654 lbs.
§Mean force on the two wedges, 12,456 lbs.

The following table gives the results of trials on wood ties:

Nature of ties.	Forces on the screw spikes—Without treenails.	With treenails.
New oak ties, creosoted	13,668.5 lbs.	15,873.1 lbs.
Piece of new good spruce, creosoted.....	7,936.5 "	11,023.0 "

Apart from the experiments related above, and which were made in my presence, I have embodied the results of similar experiments executed by the employees of the P. L. M. Co., some days before. It was interesting to compare the results obtained with

a more complete series, in which the wood ties tested were with or without treenails. It is not necessary to give here the details of these experiments, it would be, in fact, going beyond the outline of the study which we have undertaken, but it is fitting to remember that the resistance to withdrawal of the screw spikes is the following:

1st.	In pine ties	Approximately	7,716 lbs.
2d.	In pine ties with treenails	"	11,023 "
3d.	In new oak ties	"	13,228 "
4th.	In new oak ties with treenails	"	15,432 "
5th.	In oak ties in service for eight years	"	7,496 "
6th.	In oak ties in service for 8 years, new treenails	"	12,125 "
7th.	In oak ties with old treenails	"	7,496 "

The limit to extraction of the screw spikes in the composite cross ties is raised as an average to 12,456 lbs., that is to say, to a figure which is very near that which was obtained with new oak ties; the wood of the wedges was, however, of bad quality, presenting a good many fissures, and having all the appearances of being split by frost. Their own resistance was certainly inferior to that which it would have been if the material employed had been sound. The central wedge once in place, no longer rises, whatever may be the pressure to which the screw spike is submitted; the fastening is then secured in a certain fashion, and even more efficiently than it is generally, by reason of the compression of the fibers of the wood. The wedging, or rather the squeezing, of the pieces of wood, which one would consider *a priori*, as one of the weak points of a composite cross tie, becomes, on the contrary, one

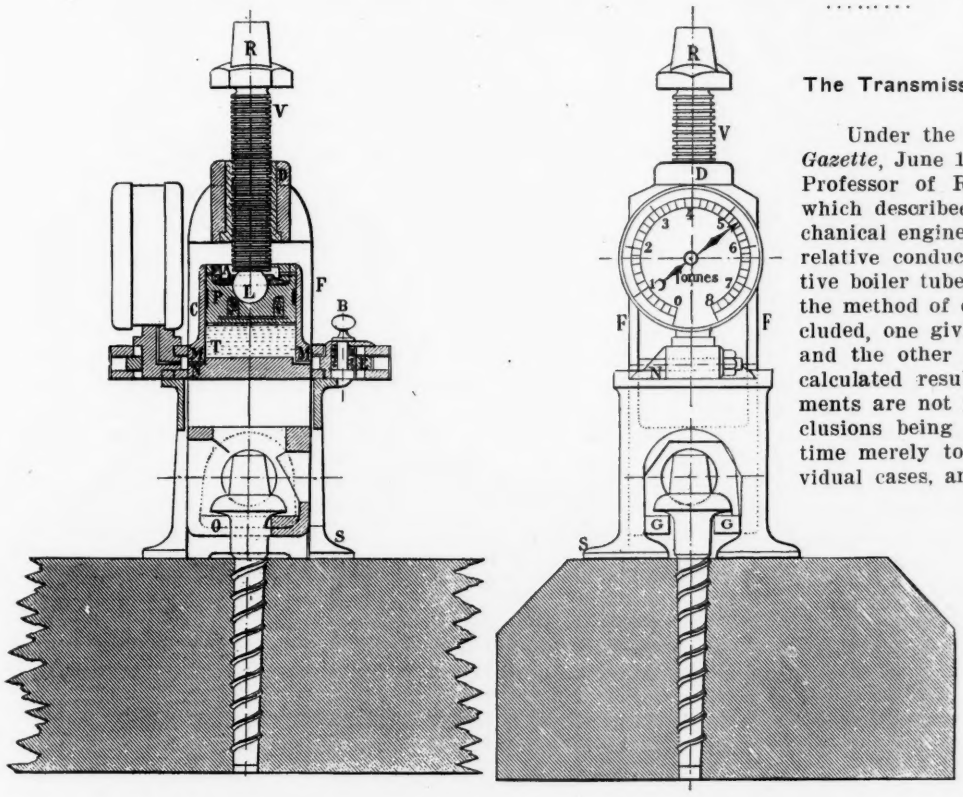


Fig. 13—The Extrahometre, Vertical Section and Front View.

of its principal advantages; it seems that the bringing together of the fibers of the wood arising from the squeezing, gives to that material a resistance superior to that which it would have had in a free state. It is that which explains also the reason why the employment of the treenail in ties gives a superior resistance to that of the wood which constitutes them; the treenail has not, so to speak, any resistance of its own. That which demonstrates it, is that the limit of extraction varies according to the nature of the wood which envelops it, and which latter is, so to speak, the intermediary between the resistance of the treenail and that of the wood, which surrounds the latter. It follows that this resistance ought to hold the fibers of the wood envelope in compression more or less great, since the more fibrous and elastic the wood is, the more considerable is the resistance.

Thus the compression of the wood constitutes one of the principal merits of the tie, and in order to exhibit it, I have provided the wedges with treenails. The result has been what was expected; the compressed horizontal fiber of the blocks reacted on the vertical fiber of the treenail, and the resistance was increased by about 20 per cent., that is to say, that with blocks composed of sound wood, fibrous and elastic, and with treenails introduced at the point where the fastenings are placed, a resistance was obtained which surpassed known limits. It was interesting, consequently, to make new experiments with that idea, and to see how cross ties, composed of wooden blocks of the kind indicated above, would behave. For that effect, cross ties provided with wooden blocks of hornbeam and elm were experimented with like the preceding, but unfortunately, the woods employed were absolutely baked, and the trials offered no more than a relative interest.

In spite of these very disadvantageous conditions, the results have nevertheless been very satisfactory, since there was obtained on a middle wedge a force of 19,621 lbs. (limit of power of the *extrahomètèr*), and on the lateral wedges forces varying between 15,432 lbs. and 16,094 lbs. The results of this last experiment are set down in the following table:

Composite Ties.

Forces on the screw spikes of the wedges — In the middle.	On the sides (lateral.)	Raise of middle wedges.	Observations.
	1*st.*	*Horn-beam wedges.*	
14,330 lbs.	15.432 lbs.	.....	Mean force on a lateral wedge, 15,300 lbs.
17,637 "	16,094 "	.....	
14,110 "	15,432 "	.....	
12,346 "	14,992 "	.....	These blocks were prepared specially for the tests; they were not creosoted, because they were not to be used in the tracks; they were in full process of decomposition, as we have been able to account for it to ourselves, having broken several of them.
.....	14,110 "	.....	
.....	15,983 "	.....	
.....	14,330 "	.....	
.....	15,983 "	.....	
	2*d.*	*Elm wedges.*	
12,676 lbs.	13,669 lbs.	.....	Wood as above.
13,779 "	12,676 "	.....	
11,023 "	13,448 "	.....	
10,472 "	13,228 "	.....	
.....	11,684 "	.....	
.....	13,007 "	.....	
.....	11,905 "	.....	
.....	12,566 "	.....	

(To be continued.)

The Transmission of Heat Through Scale-Covered Boiler Tubes.

Under the above caption there was published in the *Railroad Gazette*, June 14, 1901, an article by Edward C. Schmidt, Associate Professor of Railway Engineering at the University of Illinois, which described a series of experiments made by the railroad mechanical engineering department of the university to determine the relative conductivities for heat of clean and scale-covered locomotive boiler tubes. The apparatus was described and illustrated and the method of conducting the tests explained. Two tables were included, one giving the principal characteristics of tubes and scale, and the other a summary of the data of the tests and also the calculated results. In conclusion it was stated that "the experiments are not yet numerous enough to permit of any general conclusions being drawn from them, and they are presented at this time merely to show what the heat loss may amount to in individual cases, and to indicate also how widely this loss varies with different sorts of scale. It is the intention to continue these experiments and to accumulate enough data to warrant some general conclusions concerning the relations existing between conductivity and the thickness, hardness and other physical and chemical properties of the scale."

Two additional series of experiments have been made since that time, in 1904 and 1905 respectively. The apparatus (Fig. 1) was practically the same as that used in the first series, except that a Le Chatelier pyrometer was used instead of a copper ball to insure greater accuracy in the measurement of furnace temperatures. The data and results of all of the tests form the subject matter of Bulletin No. 11 of the Engineering Experiment Station of the College of Engineering of the University of Illinois, which is now in press. A summary of this bulletin was prepared by Professor Schmidt for presentation to the March meeting of the Western Railway Club. Information concerning each of the tubes tested in the three series and the character of scale on each, and all observed and calculated data for each tube for each test, is given in a set of four tables which are not reproduced here. The last of these is a summary of the other three and from it four diagrams were plotted, which are reproduced herewith (Figs. 2, 3, 4 and 5). What follows is taken from the paper.

The apparatus in which the tubes were tested may be roughly designated as a single-tube boiler or heater. It consisted essentially of a long water chamber, through which the tube to be tested was passed, and through which water was circulated. At one end of this water chamber was fastened a combustion chamber with which the tube communicated. The heat delivered to the tube was supplied by the combustion of gas in this chamber. The heat abstracted from the tube was determined by weighing the water which passed around the tube and through the water chamber, and by noting its rise in temperature. For each series of tests the gas and air needed for combustion were delivered to the burner at constant pressure for all tests, and in approximately the same amounts. The water chamber consisted of a piece of pipe with flanged heads. A stuffing box in each of these heads permitted the tubes to be easily put in position. The tank above the water chamber furnished the water supply and was arranged to maintain a constant head on the water chamber inlet. In the combustion chamber, im-

mediately in front of the entrance to the tube, was placed the pyrometer, and the burner was located at the opposite end. Air and gas were supplied to the burner from the tanks at the left. Each of these was a small gas holder, consisting of an inner tank open at the bottom and floating on water contained in the outer tank. The pressure of the air or gas contained in the inner vessel could be varied at will by weighting the holder.

The purpose of the tests was to determine the number of British thermal units transmitted per hour through each tube. This equals the weight of water circulated, multiplied by its rise in temperature. * * * The conductivity of the tube, or the B.t.u. transmitted per unit of time, varies directly as the range of temperature between the inner and outer tube surfaces. This range of temperature is the difference between the mean pressure of the water and the temperature of the gases. The amount of heat actually transmitted during each test is reduced to what it would have been had this range during all tests been the same as the average range existing during the tests of the clean tube. These derived figures, compared with the heat transmitted through the clean tube, give the effect of the scale in each case. * * * The four diagrams exhibit the loss due to scale in relation to its thickness, its structure, and its chemical composition. Fig. 2 shows the loss due to scale plotted with reference to its thickness. Fig. 3 is identical with Fig. 2 except that the letter H, S or M has been added at each point to indicate that the scale is either hard, soft or medium. In Fig. 4 the loss is plotted with reference to the sum of the percentages of calcium carbonate and magnesium carbonate, and in Fig. 5 this loss is plotted with reference to the amount of calcium sulphate.

In the series of 1901 there were a few tests which indicated

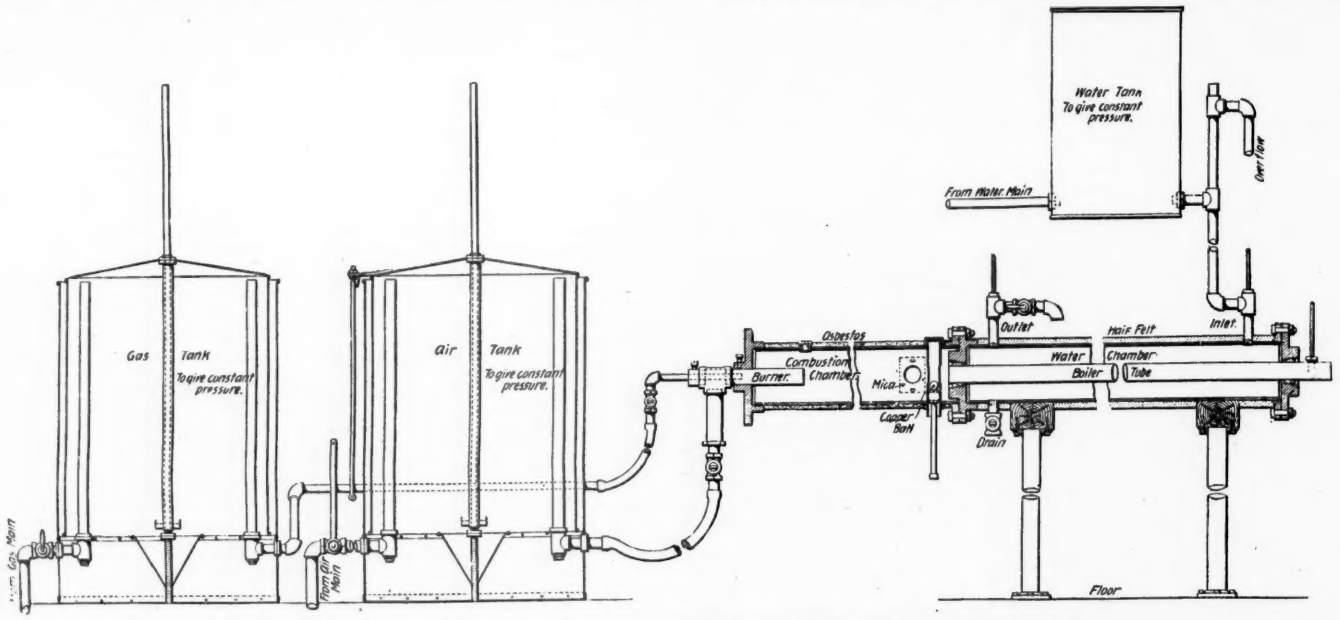


Fig. 1—Apparatus to Show Heat Transmission Through Scale-Covered Boiler Tubes.

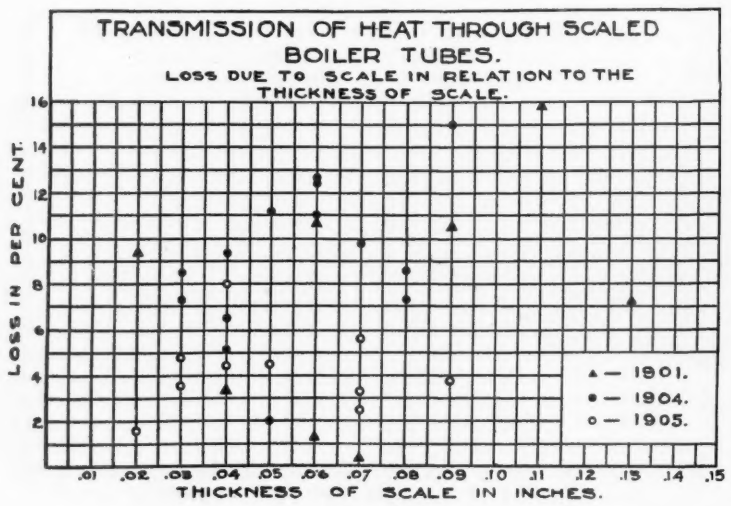

TRANSMISSION OF HEAT THROUGH SCALED BOILER TUBES.
LOSS DUE TO SCALE IN RELATION TO THE THICKNESS OF SCALE.
LOSS IN PER CENT.
THICKNESS OF SCALE IN INCHES.
▲ — 1901.
● — 1904.
○ — 1905.

Fig. 2.

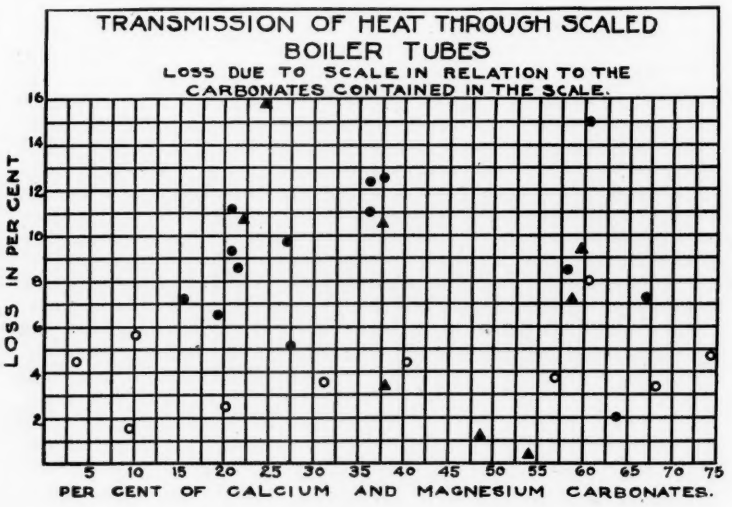

TRANSMISSION OF HEAT THROUGH SCALED BOILER TUBES
LOSS DUE TO SCALE IN RELATION TO THE CARBONATES CONTAINED IN THE SCALE.
LOSS IN PER CENT
PER CENT OF CALCIUM AND MAGNESIUM CARBONATES.

Fig. 4.

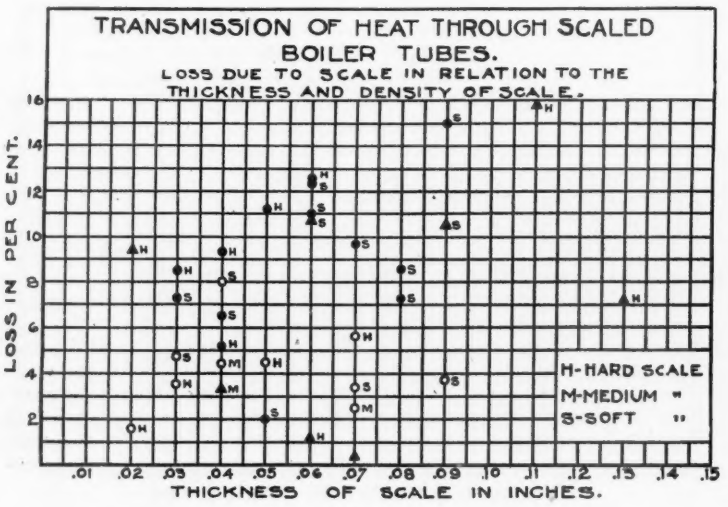

TRANSMISSION OF HEAT THROUGH SCALED BOILER TUBES.
LOSS DUE TO SCALE IN RELATION TO THE THICKNESS AND DENSITY OF SCALE.
LOSS IN PER CENT.
THICKNESS OF SCALE IN INCHES.
H-HARD SCALE
M-MEDIUM "
S-SOFT "

Fig. 3.

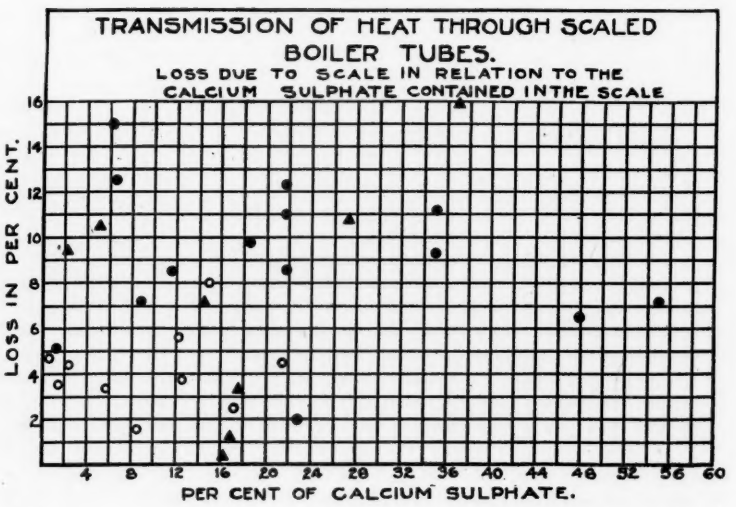

TRANSMISSION OF HEAT THROUGH SCALED BOILER TUBES.
LOSS DUE TO SCALE IN RELATION TO THE CALCIUM SULPHATE CONTAINED IN THE SCALE
LOSS IN PER CENT.
PER CENT OF CALCIUM SULPHATE.

Fig. 5.

Losses in Heat Transmission Through Boiler Scale.

an increase of conductivity of the scaled tube as compared with the clean tube. These were perhaps to be accounted for by errors in conducting the experiments, although they could not be detected at the time the experiments were made. The apparatus used in 1904 and 1905 was improved in some particulars, the most important change being in the means for the measurement of furnace temperatures, as already mentioned. Such discrepancies disappear in the later series.

When the experiments were planned it was considered probable that the transmission of heat through the scale was principally dependent upon two of its characteristics, namely, its thickness and its mechanical structure, and that probably, for such thicknesses as are usually met with, thickness had greater influence than structure. Thickness was therefore carefully determined and structure approximately designated as hard, soft or medium, no more exact characterization of structure being possible with tubes collected from different sources, as these were. It was hoped that the experiments might develop, if perhaps only approximately, some law of variation of conductivity with thickness. After making allowance for possible errors due to the method of conducting the tests, consideration of Fig. 2 shows perhaps a decrease of conductivity with thickness, but certainly no regularity of variation. In Fig. 3 the loss in heat transmission is again plotted with reference to thickness, and the structure of the scale, in so far as it was determined, is indicated as previously explained. No regularity of variation is observable with respect to hardness or softness.

In considering Figs. 2 and 3 it must be borne in mind that the tubes tested were taken from locomotives which had been in service in different parts of the country and that the scale on each tube was made up of the mineral constituents of many different water supplies. What is designated as hard scale in one case may be very different in structure—in porosity, for example—from what is designated as hard scale on another tube. Fig. 3 cannot therefore be considered as providing conclusive evidence concerning variation of conductivity with structure. The results may properly be interpreted as indicating that mechanical structure is at least as important a factor in the change in heat transmission due to scale as is the mere thickness. Such a conclusion is, of course, in accord with the facts concerning other heat insulators.*

Water and vapors are known to be poor heat conductors. Experiments on the conductivity of metals by Fourier and others, in which the heat transmitted was measured by its absorption in water, proved that unless care was exercised to constantly remove the film of water next the metal, the low conductivity of this water layer so affected the results as to make it difficult to distinguish the effect of differences in thickness and nature of the metals themselves. It seems probable that soft, porous scale would more effectively retain against the tube surface such a layer of water or vapor of low conducting power. Such facts seem to indicate that we should accept with caution the assumption that hard scale will cause a greater loss than soft scale.

Figs. 4 and 5, in which the loss in heat transmission is plotted with reference to the principal chemical constituents of the scale, do not warrant the conclusion that its chemical composition has any direct influence on its conductivity.

From the point of view of the physicist the experiments are open to objection as to method. From the engineer's viewpoint it is believed that the possible errors of the experiments do not by any means account for all the irregularity in the plotted results and, considering the controversy upon the subject and the comparatively meager information available, it is deemed proper to publish at this time the results as they stand in the hope that they contribute additional information which may be of interest in some quarters.

CONCLUSIONS.

In so far as generalization is warranted, we may sum up the results of the tests in the following conclusions:

1. Considering scale of ordinary thickness—say of thicknesses varying up to ⅛ in.—the loss in heat transmission due to scale may vary in individual cases from insignificant amounts to as much as 10 or 12 per cent.

2. That the loss increases somewhat with the thickness of the scale.

3. That the mechanical structure of the scale is of as much or more importance than the thickness in producing this loss.

4. That chemical composition, except in so far as it affects the structure of the scale, has no direct influence on its heat transmitting qualities.

The Bavarian authorities announce that since the effort to guard against tuberculosis began in 1878, there has been a great reduction in the number and mortality of the cases among railroad employees, but still 18 to 20 per cent. of the deaths are due to it; and they have issued new regulations, intended to still further prevent the disease.

*In discussing the effect of structure it seems to be quite generally assumed that hard scale will reduce the conductivity of the tube more than soft scale. This assumption, moreover, is generally made without the reasons or data being adduced. It may eventually prove to be correct, but there are reasons for anticipating that, when the matter is settled experimentally, we may find that soft scale will cause the greater loss.

The Sixth Street Viaduct at Kansas City.

BY J. A. LAHMER.
Principal Assistant Engineer, Kansas City Southern.

Kansas City has many hills and hollows. The west bottoms—on the south side of the Missouri river and on both sides of the Kaw river—are occupied by railroad yards and terminals, stock yards and meat packing plants, and other factories and warehouses. Wagon traffic from the uptown district to the west bottoms and Kansas City, Kan., passes over heavy grades and across many railroad tracks, and, during the busy hours of the day, is very congested.

A public viaduct from the west bluffs at Fourth street across the tracks which lead from the north to the Union Depot and adjacent yards, lands at the east edge of the west bottoms. It partly relieved the situation in the early days, but has long been inadequate and in addition is too far north to benefit a considerable portion of the present traffic. The next streets which afford access to the west bottoms are Sixth street and Twelfth street, from which roadways wind to the south and north, respectively, along the west bluffs. These routes are unsatisfactory on account of indirectness, steep grades and numerous railroad crossings.

A municipal viaduct to afford an easy and direct route for wagon and street railway traffic between Kansas City, Mo., and Kansas City, Kan., and the intervening bottoms was advocated in 1902 by William J. Knepp, while he was a member of the City Council of Kansas City, Mo. Approximate estimates of the cost of the structure were prepared and some investigations made as to right-of-way. However, it soon became evident that the two cities had not the necessary funds available, nor were they in a position to issue bonds for the purpose. Mr. Knepp then set about to interest private capital in the enterprise and finally succeeded in obtaining the necessary funds in the East. The Kansas City Viaduct & Terminal Railroad Co. was organized and a toll viaduct built. This structure is known as the Sixth street viaduct, but is also often referred to as the Intercity viaduct. It extends from Sixth and Bluff streets in Kansas City, Mo., to Fourth street and Minnesota avenue in Kansas City, Kan., and for the greater portion of its length is located between the Missouri river and the tracks on the south side of this stream on land which was formed by accretion.

The length of the main viaduct is 8,400 ft., including an earth approach 381 ft. long, at the Kansas end. Beginning at the east end, there is a $1^5/_{10}$ per cent. descending grade for 843 ft.; a $^5/_{10}$ per cent. descending grade for 2,362 ft.; a $^5/_{10}$ per cent. ascending grade for 2,091 ft.; a $^{74}/_{100}$ per cent. ascending grade for 45 ft.; a $1^5/_{10}$ per cent. ascending grade for 1,415 ft., which ends at the east end of the bridge across the Kaw river; a $^5/_{10}$ per cent. ascending grade 609 ft. long across the Kaw river bridge and 1,035 ft. of a $1^5/_{10}$ per cent. ascending grade to the west end of the viaduct. The grades which are shown on the general plan, Fig. 1, are incorrect. It was necessary to eliminate the level grade in order to meet the wishes of the company which provided the paving for the roadway. There are three 3-deg. curves in the alinement, which are respectively 683, 653 and 190 ft. long.

The spans are supported by steel columns which rest on concrete pedestals; the latter in turn rest on piles—12 under each pedestal. The bottoms of the concrete footings under the pedestals are above low water in the Missouri river. It was originally intended to use concrete piling throughout for the purpose of providing satisfactory protection against decay near the surface of the ground The first plan was to drive hollow metallic forms and fill them with cement as the forms were withdrawn, but on account of difficulty experienced by the contractor in doing work in this manner for a warehouse foundation in Kansas City, this method was abandoned. It was found that where these forms were driven through quicksand, a great deal of the concrete was lost by flowing outside the space intended to be occupied by the pile. Concrete piles were then made in forms on the surface of the ground at the site of the work and jetted into position. The cross-section of these piles is approximately an octagon and they are about 14 in. in diameter at the large end and 10 in. at the tip. It was late in August before the moulding of the concrete piling was started. While the weather was warm, the piles would be strong enough to drive within seven days after making and the driving was effected with but little difficulty. As the fall season advanced, the setting of the concrete became so slow that it required 30 days or more for the piles to become hard enough to drive. After driving about 800 concrete piles, yellow pine piling treated with 12 lbs. of creosote per cubic foot was adopted. The concrete piles are from 30 ft. to 35 ft. long and the timber piles from 35 ft. to 50 ft. long.

The concrete piles consist of four ¾-in. Johnson's corrugated bars wrapped in wire netting and surrounded by a mixture com-

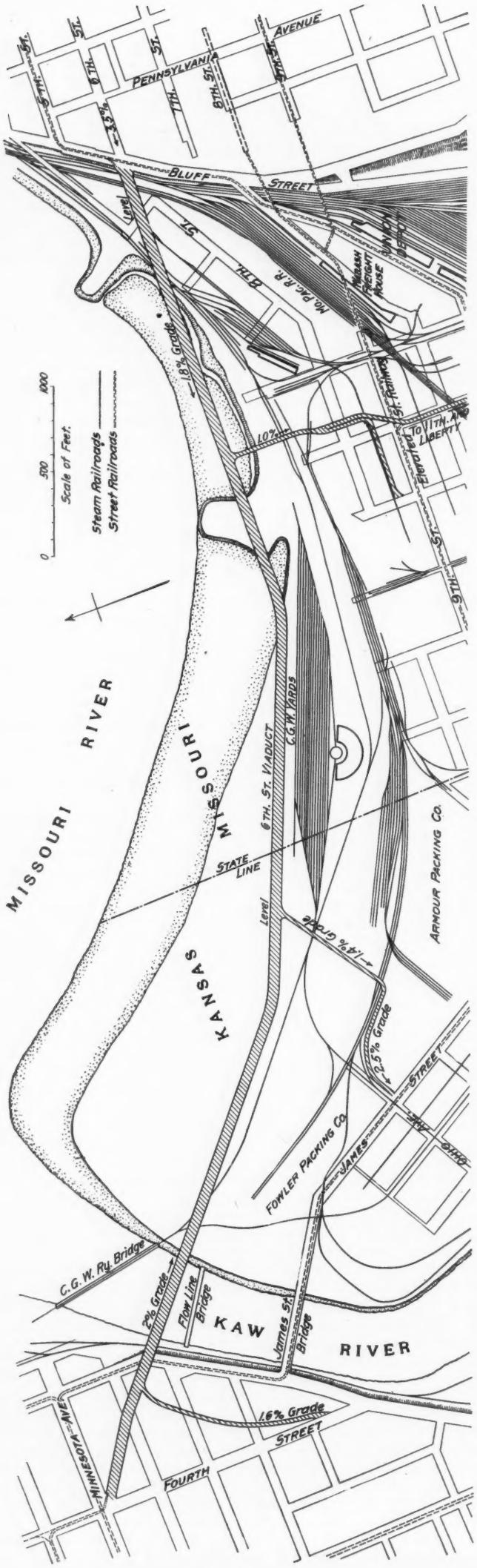


Fig. 1—Map of West Bottoms at Kansas City Showing Location of New Sixth Street Viaduct and Approaches.

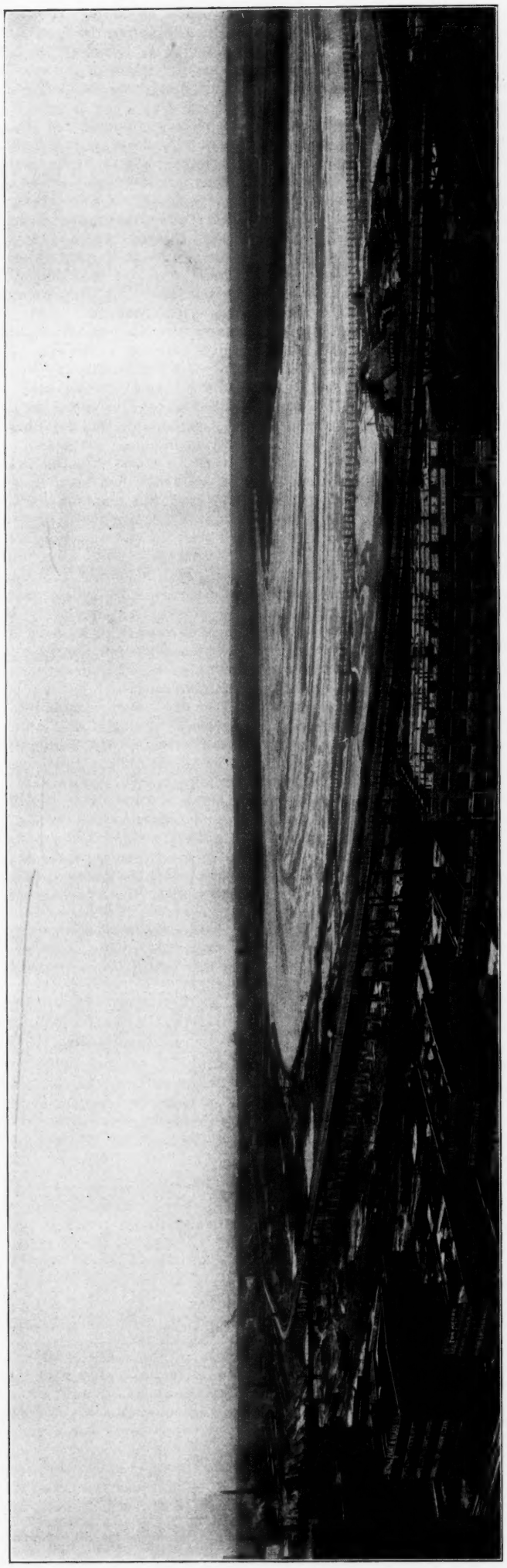


Fig. 6—Bird's-eye View of New Sixth Street Viaduct at Kansas City.

posed of one part of Portland cement, three parts of sand and five parts of stone broken to pass through a 1-in. ring. The concrete in pedestals was of the same composition as that in the concrete piling, except that the stone was 2½ in., or less, in size. The concrete in pedestals deposited in water was mixed in the proportion of one, two and three, broken stone to pass through a 3-in. ring. All ingredients in concrete was determined by volume and each

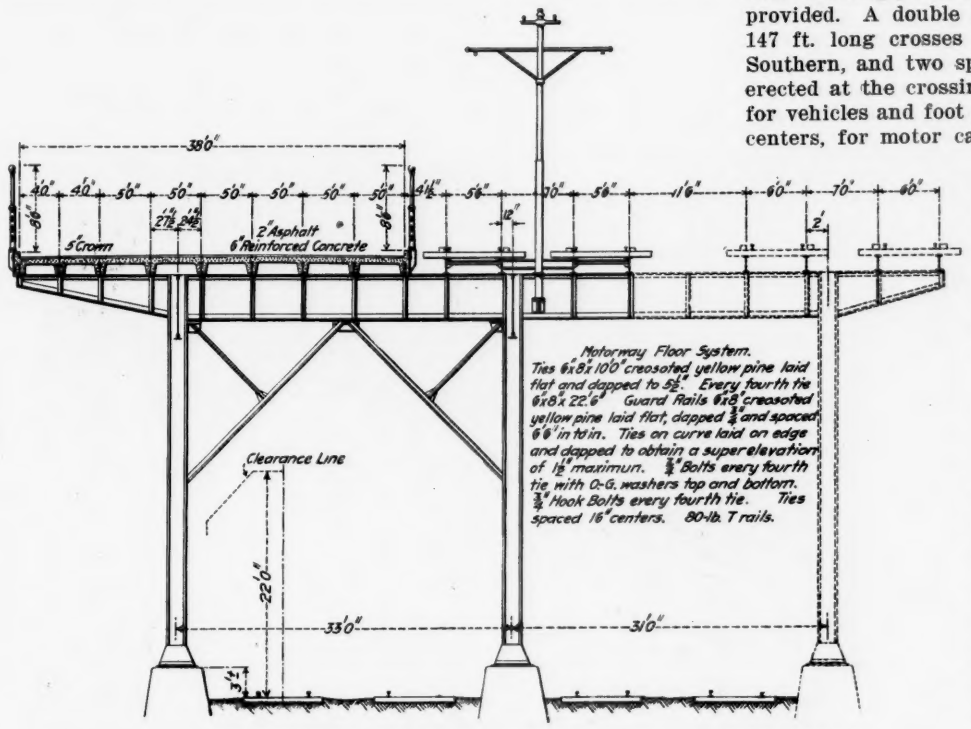


Fig. 2—Cross Section Through Viaduct Showing Future Widening for Additional Tracks.

mixture contained sufficient water to form what is known as "wet" concrete. The standard footings of pedestals on concrete and timber piles were 9 ft. by 11 ft. 3 in. in plan, with the longer dimension transverse to center line of viaduct and projected 3½ ft. below and 1½ ft. above tops of piles. The footings for pedestals through the flat east of Mulberry street were 9 ft. by 12 ft. and extended 10 ft. below tops of piles and 3 ft. above tops of piles. The neat work of pedestals is 12 ft. high, 6 ft. 6 in. by 7 ft. 6 in. at the base and has a batter of 1½ in. to the foot. The corners are rounded to a 3-in. radius.

In general the superstructure is arranged in bays, separated by expansion joints, each bay consisting of seven 45-ft. spans and one 30-ft. tower, thus spacing the expansion joints (shown in Fig. 3), 345 ft. apart. The tower span is well braced longitudinally. All columns are of steel. Where necessary to carry the viaduct over buildings, railroad tracks, streets and alleys, special spans are provided. A double intersection, riveted, Warren deck truss span 147 ft. long crosses a proposed freight yard of the Kansas City Southern, and two spans, each 300 ft. long, of the same type were erected at the crossing of the Kaw river. These carry a roadway for vehicles and foot passengers and two tracks, 12 ft. 6 in. between centers, for motor cars, the center of the inside track being 6 ft. 10½ in. from the hand-rail of the highway. The roadway is 38 ft. wide east of Mulberry street and 30 ft. wide west of Mulberry street. The present structure is built to permit a future addition of a footway 7 ft. 6 in. wide on the south side and another row of columns 31 ft. north of the present north line of columns to support another pair of tracks for motor cars.

A typical section is shown in Fig. 2. The columns of each bent are 33 ft. between centers and vary in height from 27 ft. to 52 ft., to fit the grade, the top of concrete pedestals being level. A column between 27 and 31 ft. high consists of two 15-in. 33-lb. channels, separated by a ½-in. x 16-in. plate fastened to the channels by means of four 5-in. x 3-in. x ⅜-in. angles. For higher columns, the weight of the channels was increased, but the diaphragms remained the same. The floor beams are 15 ft. apart and, between main girders, are 52-in. plate girders having a ⅜-in. web and 6-in. x 6-in. x ½-in. angles. Outside the main girders are cantilever girder arms, which are connected to the floor girders by a plate across the top of columns; the thrust at the bottom is transferred by means of a cast iron block between the outside channels of the columns. At every bent there are angle iron braces across the corners between floor beams and columns. On top of the floor beams there are 12-in., 31½-lb. I-beams, 5 ft. between centers, under the roadway for vehicles, and one 18-in., 55-lb. I-beam under each rail of the tracks for motor cars. Longitudinal bracing is provided in every seventh panel on tangents and every fifth panel on curves, except that in a few instances, on account of undercrossings by streets or tracks,

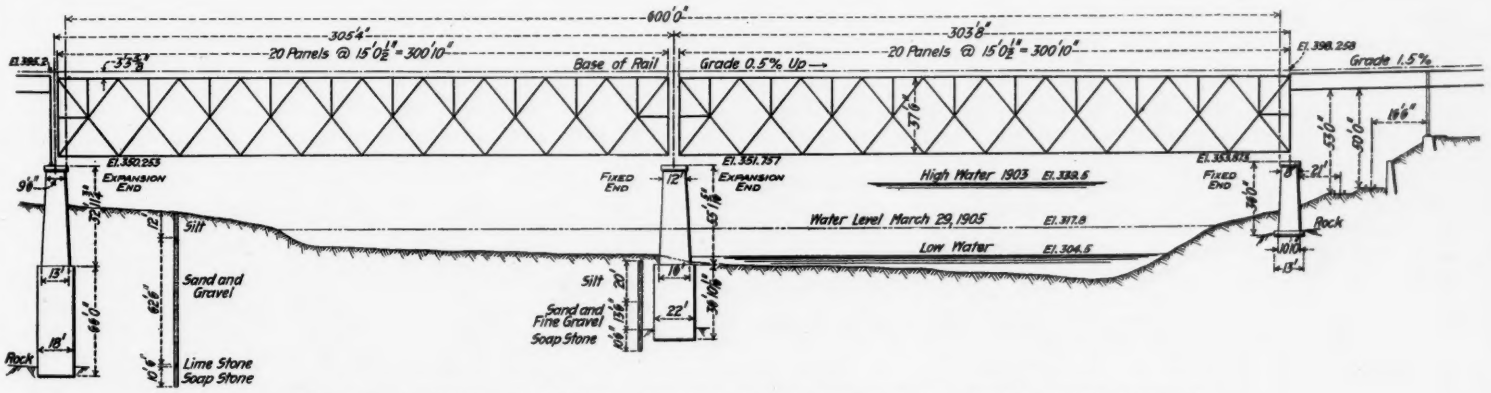


Fig. 4—Elevation of Bridge Over the Kaw River for the Sixth Street Viaduct.

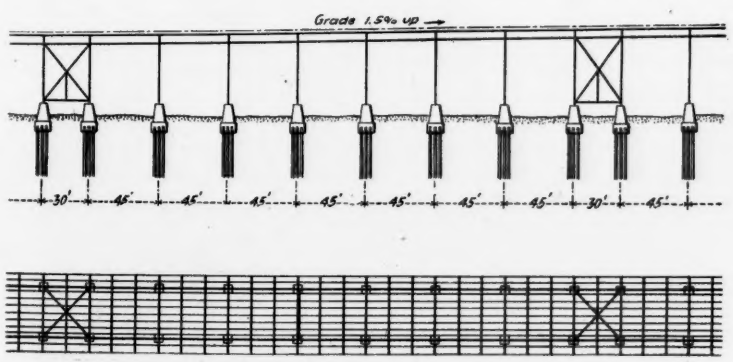


Fig. 5—Part Plan and Side Elevation of Sixth Street Viaduct.

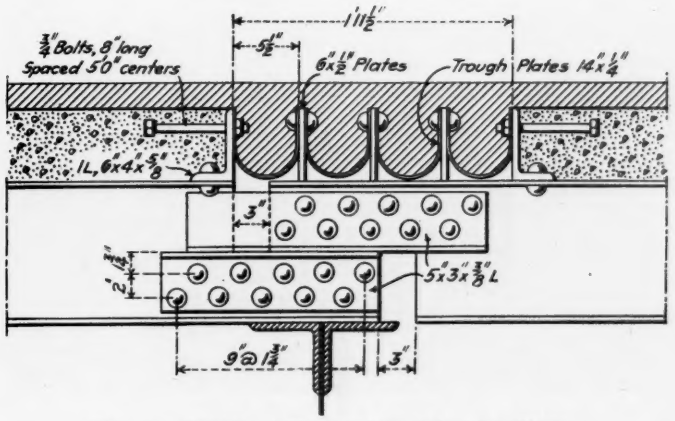


Fig. 3—Detail of Expansion Joint in Floor.

every eighth panel on tangents was braced longitudinally.

The material for the substructure of main viaduct was delivered on surface tracks under or along viaduct. The first metal was erected by the use of a gin pole and the remainder by means of a double-boom traveling derrick.

The floor of the roadway for vehicles consists of a 6-in. layer of reinforced concrete covered by a finishing coat of 2 in. of asphalt. The highway stringers are encased in concrete, as shown in Fig. 2. The four track stringers of the motor-way floor system are braced by a 10-in. channel over each floor beam with diagonals between. The ties are 6 in. by 8 in. by 9 ft., creosoted yellow pine, laid flat and spaced 14 in., center to center, except that every fourth tie is continuous across both tracks. They are fastened to track stringers by means of hook bolts. On curves, the ties are laid on edge and dapped to give super-elevation. Guard rails are also 6-in. by 8-in. yellow pine, creosoted, and are laid flat and dapped 1½ in. Trolley poles are set between tracks.

The viaduct is to be used by cars of the Metropolitan Street Railway Co. and also by cars of the Kansas City Western Railway Co., which operates an electric line between Kansas City, Mo., and Leavenworth, Kan.

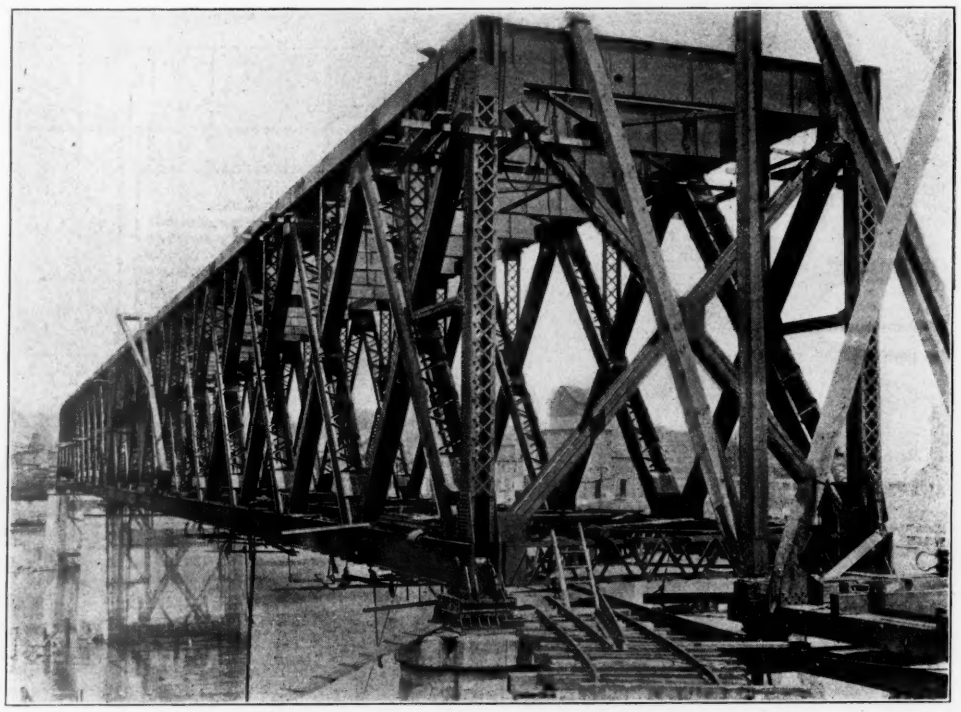
The general plan and profile of the bridge across the Kaw river is shown in Fig. 4. These spans are designed for a combined live and dead load of 22,000 lbs. per lineal foot and are examples of long, heavy, riveted spans. Each span is 300 ft., 10 in. long, divided into 20 panels and weighs approximately 1,780,000 lbs. The bottom of the trusses is about 15 ft. above the high water mark of the flood of 1903, which caused such enormous damage at Kansas City and throughout the Kaw valley. Foundations for the east and middle piers were built by the pneumatic process, and that for the west pier by open excavation.

A lateral viaduct leaves the main viaduct in the block east of Mulberry street (in Missouri), and extends south across private property and buildings to a point about 100 ft. south of Eighth street. It divides here and one portion runs thence to Ninth and Mulberry streets, where it will cross above the Ninth street elevated tracks of the Metropolitan Street Railway and will extend on Mulberry street to Eleventh street. The other portion runs westward along the alley and by an incline on a $3^{5}/_{10}$ per cent. grade reaches the grade of the street surface near Ninth and Mulberry streets. The Eleventh and Mulberry street lateral will be about 2,200 ft. long and the Ninth and Hickory street lateral about 450 ft. long.

The city contemplates the construction of a viaduct west from the bluffs at Twelfth street, which would join the Mulberry street lateral of the Intercity viaduct at Eleventh and Mulberry streets. An effort was made by the city to unite with the Metropolitan Street Railway Co. in the construction of a viaduct from Twelfth and Bluff streets, but no agreement has been reached. From present appearances, the Metropolitan will reconstruct its old Twelfth street viaduct on a steeper grade than that contemplated by the city for its viaduct. The Kansas City Viaduct & Terminal Railroad Co. at first figured on a landing for its viaduct on the surface of the street a short distance west of Eleventh and Mulberry streets, but was unable to make satisfactory arrangements for right-of-way. The present plan is to provide elevators at the south end of the Mulberry street lateral to handle traffic between the viaduct and the surface of the street, a vertical distance of about 22 ft. The Mulberry street viaduct will have a clear roadway of 24 ft., but no railway tracks.

The ordinance covering the portion of the Sixth street viaduct which is located in Kansas requires the construction of laterals on Ohio avenue and Ferry street.

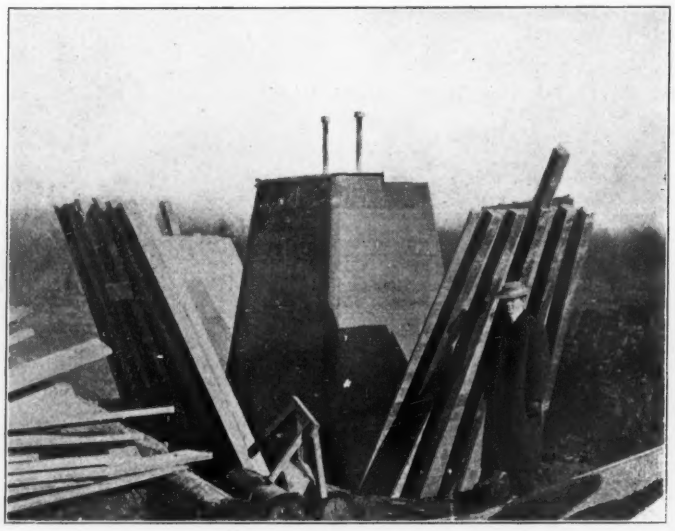
Actual construction of the Sixth street viaduct was begun August 9, 1905. The main viaduct was opened for traffic between Kansas City, Mo., and Kansas City, Kan., on January 29, 1907. Work is now in progress on the Eleventh and Mulberry, and Ninth and Hickory street branches.



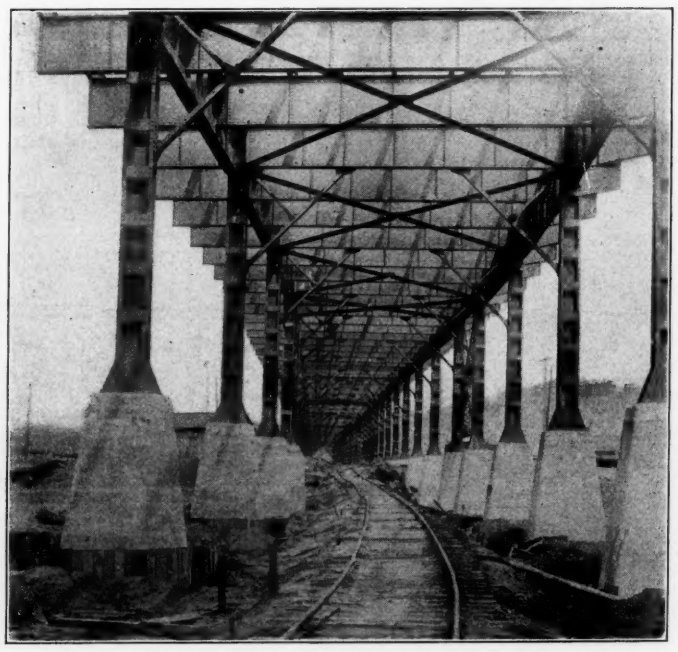
Bridge Over Kaw River for Sixth Street Viaduct.

The total cost of the main viaduct and its laterals is estimated at $3,000,000.

The general contractor for the substructure was James F. Halpin, of Kansas City, and for the superstructure, the Riter-Conley Manufacturing Company, of Pittsburg, Pa. Thanks for drawings and other information from which this article was prepared are due Mr. Ira G. Hedrick, who on the dissolution of the firm of Waddell & Hedrick, became Consulting Engineer to the Viaduct Company.



Concrete Foundation Pier with Forms Removed.



View Under Viaduct Before Laying Floor.

GENERAL NEWS SECTION

NOTES.

At Olympia, Wash., April 11, there was to be a conference of the state railroad commissions of Oregon, Washington and Montana.

At Appomattox, Va., March 25, the Norfolk & Western was fined $1,100 and costs for 22 violations of the law forbidding the running of trains on Sunday.

The pool of the Western Elevating Association of Buffalo has been established for the present season without the eight railroad elevators, the railroad companies declining to enter on the ground that such action would be contrary to law.

A press despatch from Chicago on Tuesday of this week says that the Brotherhood of Locomotive Firemen has secured from 31 railroads west of that city agreements increasing by 25 cents a day the pay of firemen on all classes of engines.

In the Federal Court in Minnesota, April 6, the Great Northern Railway was fined $1,500 for illegal payment of rebates on freight. The decision was made in pursuance of an agreement between the Government and the railroad to hasten an appeal to the higher court.

The car barn and power plant of the New York City Railway Company at Lenox avenue and 146th and 147th streets, New York City, were destroyed by fire April 8. Loss about $1,000,000. Four hundred cars were burnt up. One person was killed and ten seriously injured.

On Thursday, March 21, the number of freight cars moved over the Pittsburg division of the Pennsylvania Railroad was 7,289, which is 359 above the record of January 5. The detailed record on March 21 was: Eastbound, 127 trains, 3,578 cars; westbound, 92 trains, 3,711 cars.

The roads entering Chicago from the East have agreed to bear four-fifths of the switching charge of $5 a car on freight consigned to private sidings in Chicago on the lines of the Northwestern and the St. Paul roads. Hitherto the eastern roads have paid $3 and the consignees $2.

The executive committee of the Chicago Commercial Association proposes to relieve the congestion of traffic in the streets of that city by securing the adoption of a rule—perhaps by agreement among teamsters—which will keep heavy wagons out of the business district during business hours.

The West River Valley Lumbermen's Association, of Vermont, complains that the Central Vermont furnishes lumber cars for shipments at the rate of about four a day, while the lumber shippers desire to ship many times that quantity. It is claimed that dry lumber amounting to over 7,000,000 ft. is now waiting for cars.

Street car men in Chicago are receiving the increase in wages promised them before election in case the traction ordinances, insuring the consummation of the contract between the street railways and the city, should be carried. The increase is said to be 4 cents an hour to men of less than one year's service and 2 cents an hour to the older men.

The new railroad law which has been passed in Colorado does not go into effect until June 25, and the Governor says that he is not going to appoint the commissioners until about that time. If the appointments were made now the commissioners would be unnecessarily troubled with complaints against the railroads and with application for positions.

Transmissouri roads have agreed to put into use in Kansas on and after May 1 next a 2,000-mile interchangeable ticket, business in connection with the use of which will be handled under the rules of the interchangeable bureau of the Western Passenger Association. Heretofore interchangeable mileage has been limited to the territory east of the Missouri river and to Nebraska.

The New York, New Haven & Hartford has issued an order forbidding permissive block signaling on lines worked by the telegraph or the controlled manual block system, except in case of emergency. If a train in the block section requires assistance another may be moved forward on a regular train order from the despatcher. In case of the failure of wires or bell apparatus a caution card may be issued.

The new union station at Mobile, Ala., is to be opened on Thursday, April 18. The Gulf Terminal is the name of the company organized to operate the new terminal. It is owned by the Mobile & Ohio and the Southern. At the opening ceremony there will be addresses by Mayor Lyons, Governor Comer, President Finley, General Manager Taylor, Colonel Russell and others. A dinner to celebrate the occasion will be given at the Hotel Cawthon following the opening ceremonies.

According to a press despatch from St. Paul the Minneapolis & St. Louis, having given due notice a month ago, is now selling tickets to Chicago in blocks of 100 at the low rate of $6 each. As these tickets are transferable and good for a year, the arrangement would seem to have been designed for the special benefit of the scalpers, and it seems that we are now to see how it looks to have this demoralizing business carried on partly in daylight.

W. O. Jackson, Chief Inspector of Railroads for the Ohio Railroad Commission, acting under a special appointment for the Georgia Railroad Commission, has made an examination of the Georgia Railroad & Banking Company's line, and reports that he finds nothing of the "dreadful conditions" alleged in the complaint on which the examination was ordered. He says the track conditions of the railroad rated 80 per cent. of perfect, compared with railroads with which he has had to do.

It is announced that the Great Northern Railway has decided not to replace the mammoth freight steamer "Dakota," which was wrecked on the coast of Japan a few months ago, and the principal reason for this decision, according to the report, is that the purpose aimed at in building the two great freight steamers has been accomplished. This purpose was to compel the other lines between Puget Sound and Asia to make favorable contracts with the Great Northern Railway for through traffic.

The state railroad commission of Ohio has issued a decision in which new demurrage rules are laid down. The railroads are commanded to allow 72 hours' free time on cars holding 30 tons or more, and to give consignees the benefit of the "average plan" of settlement for demurrage. Under this plan if a man unloads a car in one day less than the allowed free time, he must have a credit of one day on other cars which he detains more than 48 hours, though no car is to be entitled to a credit of more than seven days.

Over eleven million pieces of baggage were handled by the Pennsylvania Railroad in 1906, an increase over 1905 of 188,446 pieces. The total receipts of the baggage department in 1906 (extra baggage, storage, etc.) were $1,084,470. Included in this sum were $114,923 for transportation of newspapers; $63,487 for package transportation between Philadelphia and suburban points; $72,606 receipts at package rooms and $435,648 for the transportation of milk and cream. Of the claims paid in 1906 almost half of the entire sum was paid for nine trunks.

The policy of the principal railroads to postpone many projects for new construction has resulted, according to Chicago reports, in a decided increase in the supply of labor and a decrease in the scale of wages. A year ago none of the western roads could get enough laborers, and wages ranged from $1.50 to $2.25 a day. Now Italian Greek, Austrian and Belgian laborers are far in excess of the demand. They are thronging the labor agencies in Chicago, St. Louis, Kansas City, Cincinnati, Pittsburg and other cities, and gladly paying $3 each to the labor agents for finding work for them. The wages now offered range from $1.25 to $1.50.

The McRae Terminal Company, of McRae, Ga., has asked the Interstate Commerce Commission to direct the Southern Railway and the Seaboard Air Line to make track connections with the line of the terminal company. The application is based on the provision for cases of this kind which was put into the Interstate Commerce Commission law last June, and it is accompanied by the declaration that, although the terminal company, now operating one mile of road, expects to operate a regular line of railway, originating sufficient freight to warrant the construction of the desired connections, the roads named have thus far refused to lay the tracks.

A passenger desiring recently to secure a berth in a sleeping car from Chicago to Philadelphia over the Pennsylvania lines on presentation of two mileage tickets, one for the lines west of Pittsburg and one for the lines east, was refused, the railroad holding that, as the mileage tickets are issued solely for local use in carefully designated territories, it would be an illegal discrimination to consent to the use of such reduced rate tickets for a through journey over a line where the reduced rate had not been posted according to law. Therefore, the combination cannot be honored, either in checking baggage or in the sale of through sleeping car tickets.

The signal department of the Chicago & North-Western has been put under the jurisdiction of the engineering department, and henceforth division engineers in their respective territories will have charge of the construction, maintenance and operation of signals, reporting to and receiving instructions from the Signal Engineer on all these matters. Supervisors of signals will be appointed by the Division Engineer with the approval of the Signal Engineer.

The Signal Engineer reports to the Chief Engineer on important new work; to the General Superintendent on operating questions, and to the Engineer of Maintenance on maintenance and minor construction.

It is announced in Chicago that after numerous conferences the western railroads have agreed to slightly lengthen the schedules of through trains. The minimum time to be made by any passenger train from Chicago to Kansas City and Omaha after June 8 will be 14 hours. This is about the average time now, although a few trains make the run in 13 hours. The minimum time between Chicago and Denver was fixed at 32 hours, which is a little longer than the average time of the best trains now. The minimum schedule from Chicago to San Francisco will be 72 hours. The present time of the fastest trains is 69 hours and 30 minutes. No change was made in the minimum schedule from Los Angeles to Chicago, which is 72 hours.

On May 1 the Pacific Express Company, which operates over the Union Pacific, the Missouri Pacific and the Wabash, will begin service on several electric lines in western Ohio. This is the first advent of an old-line express company into the electric line traffic in that part of the country. Contracts have been made with the Dayton & Troy, the Springfield, Troy & Piqua, the Western Ohio and the Toledo Urban & Interurban line. Through express cars will be put in service on the lines mentioned. The Wells-Fargo Express is expected to establish service on the electric line from Marion to Columbus, connecting at the former city with the Erie. The American Express Company has for a year or two done a heavy express business on street railways in and near New York City.

During the year 1906 the length of lines of the Pennsylvania Railroad was increased only 64.01 miles, but 660.91 miles of new track was built. Energies of late have been devoted to building sidings, terminals, third and fourth tracks and relief lines to take care of the enormous quantity of freight traffic with which the company has been burdened. More than half the increase in trackage during the past six years, or 1,863 miles, is in company sidings. The Pennsylvania is now a four-track line from New York to Pittsburg, with the exception of two short stretches of three-track line in the mountain divisions. To-day the slow freight trains going from Altoona to Harrisburg, a distance of 131 miles, stop only once for coal; the fast freight trains run through without any stop. The Pennsylvania system operates 10,977 miles of line, and 23,109 miles of track. It operates 4.88 per cent. of the total mileage of the country, and 7.2 per cent. of the total trackage of the country.

According to Chicago gossip, President Ripley, of the Atchison, Topeka & Santa Fe, has made an ineffectual demand upon the post-office authorities for the temporary privilege of transporting the mails from the East to southern California, which have been badly delayed by washouts on the Ogden route. Citizens of Pasadena, Los Angeles and other places were complaining because of the irregularity; but the Post Office Department declared that the mails could not be diverted without transgressing all precedents. The mails are now being weighed for the next four-year estimate, and a diversion might work great injustice to the road from which the diversion was made. It appears that the regular southern California mail route was interrupted by a washout on the San Pedro line at Caliente about a month ago, and the Los Angeles Limited train was taken off. Then the southern California mails were taken by the way of Sacramento until washouts interrupted that route.

New Smokeless Locomotive on the Brussels-Ostend Line.

The *Journal des Transports* is authority for the statement that a test is being made of a new type of locomotive on the Brussels-Ostend line in Belgium which possesses the double advantage of being able to haul very heavy trains and of emitting neither smoke nor steam. These usual evidences of the work done by a locomotive, instead of being thrown out of the stack, are caught and turned back into the firebox, where they are burned and decomposed. Further, the cinders, instead of being thrown out on the right of way, are caught and carried on the outside of the machine in the same way. The system is said to resemble, in principle, that of the incinerating plant used in the neighborhood of Brussels. It is said that *if* the process proves to be a success it will be applied to all of the Belgian locomotives.

The Soliciting Agent's Glee.

When freight agents had to hustle for traffic and the railroads were hungry for business, many a shipper inconsiderately allowed them to cool their heels in ante-rooms, but now it's different. Excess of business and car shortage helps more than one agent to get even with those who formerly failed to appreciate the value of his time. The shipper is doing the calling. One agent says:

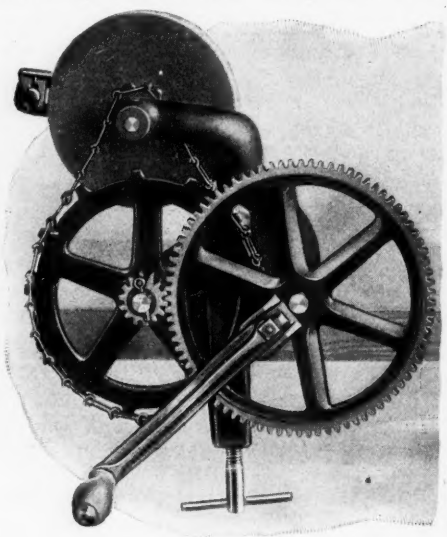
"I readily recall how often when I called at some offices the office boy was instructed to tell me to wait, and I listened with impatience and vexation as the shipper lounged in his private sanctum and laughed and joked with social callers. Now it is our turn. This year will teach many a shipper a lesson in common civility and ordinary courtesy. The telegraph companies meanwhile are reaping a harvest, shippers keeping the wires hot trying to trace their freight. Of course, there are shippers who know how to treat a man, and we about break our necks trying to help such men."—*Selected.*

New Steel Tug for the Lehigh Valley.

The steel sea-going tug "Irvington" was recently received by the Lehigh Valley Railroad from the Burlee Dry Dock Co., Port Richmond, Staten Island, and is being fitted for service. The "Irvington" made her trial trip on March 26. She is a sister tug to the "Wyoming," which was received a month or more ago; these two are the largest in the company's service, and will go into service between Perth Amboy and Boston and other eastern ports. The "Irvington" is 152 ft. long, 28 ft. 6 in. beam, and the depth of hold is 16 ft. She has a four-furnace Scotch boiler 15 ft. in diameter and 12 ft. long, with a working steam pressure of 180 lbs. The engines are triple expansion, 17-in., 25-in. and 43-in. x 30-in., and will develop 900 h.p. Her towing capacity is 6,000 tons. The bunkers hold 300 tons of coal.

The Buda Portable Drill Grinder.

A strong and efficient portable grinder is illustrated herewith. Designed primarily for railroad work, it is claimed that it will do any work reasonably required of it. The grinding wheel is carborundum, which cuts rapidly, never becomes "dull" and does not affect the temper of the tool. Proper use of these grinders requires that they be driven at high speed and the metal applied with only the lightest touch. Slow speed and heavy pressure injure both wheel and tool. These wheels really cut instead of grinding, differing in that respect from emery wheels, for example. They are claimed to be far superior to grindstones in every way, and that one man with one of these grinders can do as much as 20 men with the ordinary grindstone.



Buda Portable Drill Grinder.

The grinders are fitted with suitable attachments for grinding drills, as a part of the outfit. They are given wide bearings, securely protected from dust. The chain is the Locke steel-belt type, oil tempered, with provision for taking up the slack. They are geared to attain a speed of 3,500 r.p.m., and for hand-power driving have an adjustable malleable iron clamp for securing to any convenient bench, timber, etc. They are made in two styles, Nos. 1 and 2, the former being shown in the illustration. No. 2 is similar except that it is smaller and is intended for lighter work. The Buda Foundry & Manufacturing Co., Chicago, is the maker.

State Reductions of Passenger Fares.

The law limiting passenger fares to 2 cents a mile, which was recently passed by the Legislature of Pennsylvania, was signed by the Governor on April 5. It goes into effect on September 30, and the penalty for violation is $1,000. The Legislature is likely to pass a bill exempting roads less than 40 or 50 miles long. President McCrea, of the Pennsylvania, wrote a letter to the Governor complaining of the injustice of the bill. This letter has been made public, but seems to have had no effect with the Governor. A passenger fare bill has been passed by the upper house of the Michigan Legislature. The limit is 2 cents on all roads in the lower peninsula earning over $1,200 a mile, net. On the upper peninsula 4-cent rates are reduced to 3 cents. The 2-cent rate in Indiana goes into effect on a date to be fixed by the Governor; it was expected that the Governor's proclamation would be issued this week. The railroads of Mississippi, with the exception of the Louisville & Nashville, which works only 74 miles in that State, have decided to comply with the order of the State Railroad Commission to sell 2,000-mile books at 2 cents a mile. A 2-cent fare law has been passed by both houses of the Minnesota Legislature. The lower house of the Pennsylvania Legislature has passed a bill permitting interurban railroads to carry freight and limiting the

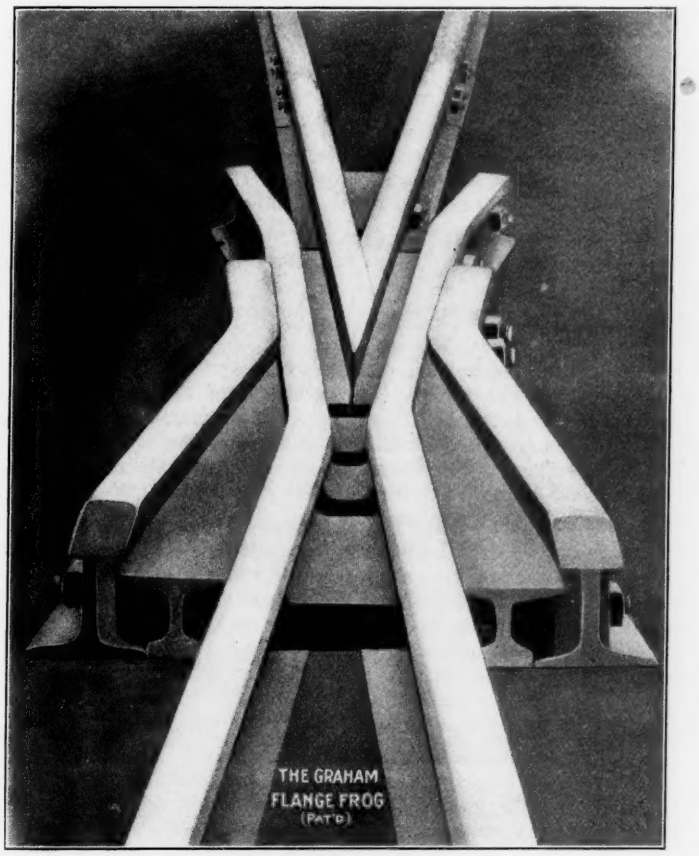
prices for berths in sleeping cars. For lower berths the limit is one-half cent a mile, for upper berths three-eighths cent, and seats in parlor cars, one-third cent.

Bids for Arthur's Pass Tunnel in New Zealand.

The time for submitting bids for boring a tunnel five miles long at Arthur's Pass through the range between Canterbury and Westland, on the line of the New Zealand Midland Railway, has been extended from March 18 to July 1, 1907. Bids will be received at the office of the High Commissioner for New Zealand, Westminster Chambers, 13 Victoria street, London, England, as noted on advertising page 22.

The Graham Flange Frog.

The Graham flange frog shown in the accompanying illustration is designed to do away with the use of a guard rail opposite the junction of the two tracks. The flange of the wheel is guided past the point of the frog by the outside flange rails which project up high enough above the top of the running rails to provide a guide for the outside edge of the tread. These flange rails extend well



The Graham Flange Frog.

beyond the point of the frog so that the flange must take the proper opening corresponding with the direction in which the truck is moving. The frog is rigidly constructed of pieces of rail and suitable fillers, the whole being bolted together with heavy bolts; compensating fillers are provided to allow for any excessive wear of flange rails. The principal advantage claimed for this frog is that it provides a positive guide for the wheel which is actually passing over the frog, whereas with a guard rail opposite the frog, the guiding effect is obtained through pressure on the back of the flange of the wheel at the other end of the axle. In case an axle is bent, or the outside wheel is loose, the opposite wheel is likely to take the wrong groove. It is also difficult to maintain the guard rails to gage, and the constant resetting and respiking soon requires the renewal of the ties to which the guard rail is spiked. Another objection to the guard rail is that a truck is likely to run askew, and when a truck in this position passes over a frog, the guard rail is depended upon to return it to its normal position. This subjects the guard rail and the wheel flanges to pressures which are often excessive and which result in broken flanges or badly worn guard rails.

One of these flange frogs has been in use for nearly a year in the Roanoke yard of the Norfolk & Western. It has been subjected to heavy train movements in both directions. It is claimed that it has required no attention and no expense for maintenance or repairs. There have been no derailments on it as yet. It is made by the American Flange Frog & Railway Improvement Company, Roanoke, Va.

Wages Raised in the West.

The long negotiations concerning wages between the railroads centering in Chicago and representatives of the conductors' and brakemen's brotherhoods were terminated on April 4 through the mediation of Martin A. Knapp, chairman of the Interstate Commerce Commission, and Charles P. Neill, United States Commissioner of Labor, who had been asked by the railroad managers to come to Chicago. The terms of agreement provide for higher rates in some cases than were originally offered by the managers. Chicago reports say that this advance will approximate $300,000 a year, which, added to the original increase offered by the railroads, will add about $6,000,000 a year to the payrolls of the forty roads involved, benefiting 50,000 employees. Both sides to the controversy yielded to the urgent appeals of the federal mediators and made concessions in the interests of peace and the welfare of the general public. The greatest concession made by the employees was the waiving of the nine-hour day.

In consideration of this the general managers agreed to grant a further advance in wages to the brakemen, baggagemen and flagmen in passenger service and an increase of 10 per cent. to employees on work trains who are now working under a ten-hour schedule. The men on work trains who now are on a twelve-hour schedule are to be put on a schedule of ten hours a day without a reduction in wages.

In the final offer of the general managers before they appealed to the government conductors on passenger trains were granted an increase of $10 a month, baggagemen $6 a month and flagmen and brakemen $5 a month. Overtime at the rate of 35 cents an hour for conductors and 20 cents an hour for other employees was offered. Men on work trains were given no increase in wages.

By the terms of the settlement baggagemen on passenger trains will receive an advance of $7.50 a month and brakemen and flagmen $6.50 a month, with overtime at the rate of 23 cents an hour. This increase averages 10 per cent., but on some of the roads it amounts to about 12 per cent. to the brakemen and flagmen. The scale for passenger conductors, averaging about 8 per cent., remains the same as originally offered by the managers.

All classes of workmen in through and irregular freight train service are granted a flat increase of 10 per cent. over the rates now in effect. In addition to the increase in pay the conditions of employment on some of the roads are materially improved.

The demand of the men in yard service in Denver and other western points for a differential of 2 cents an hour over the Chicago scale is referred without prejudice back to the separate roads to be adjusted between each road and its own employees. The railroads agree not to reduce the number of crews or increase the tonnage of trains so as to offset the increase in wages granted the employees.

The agreement was brought about without a conference between the representatives of the two sides. After discussing the whole subject with both sides, Mr. Neill and Mr. Knapp drew up the compromise agreement, and the latter laid it before the labor delegates Wednesday afternoon. He urged them to accept the proposition and told them that he believed the managers would do the same. On Wednesday evening the Government officials held a conference with the managers and paved the way for the acceptance of the modified demands of the employees.

A press despatch from Chicago the day before the settlement said that the conductors and trainmen were losing in their conference with the general managers; that "as a body the employees are beaten, and their leaders practically acknowledge it. They have put up a big bluff, had it 'called,' and have been unable to make good on their strike threats. It has been claimed by the leaders that 97 per cent. of their men had voted to strike unless their demands for a higher wage scale and shorter hours were acceded to. In reality, only 16,000 out of the membership of 50,000 claimed by the trainmen's and conductors' orders voted for a strike, the others refusing. The men have been told in plain words by Labor Commissioner Neill that they would be defeated, as they were only a small proportion of the working interests of the country; that the public were against them, and that the railroad managers would like to have them strike. They recognize that the 136 delegates sent here from all parts of the West made too large a body to be handled, and that the leaders are not large enough for the job they have undertaken."

A Wrong Principle.

A recent collision on account of failure of an inferior train to observe signals displayed for a following section by a superior train met, brings up afresh the question whether standard practice in the matter of displaying signals is not somewhat at fault. It may be worth considering whether such collisions would be so likely to occur under a practice requiring last sections and single trains representing a schedule to display a distinctive signal indicating them to be the last (or only) train running on their respective schedules. As it is, that fact is indicated by the absence of signals, while

railroad practice in all other cases regards the absence of signals as an indication of danger.

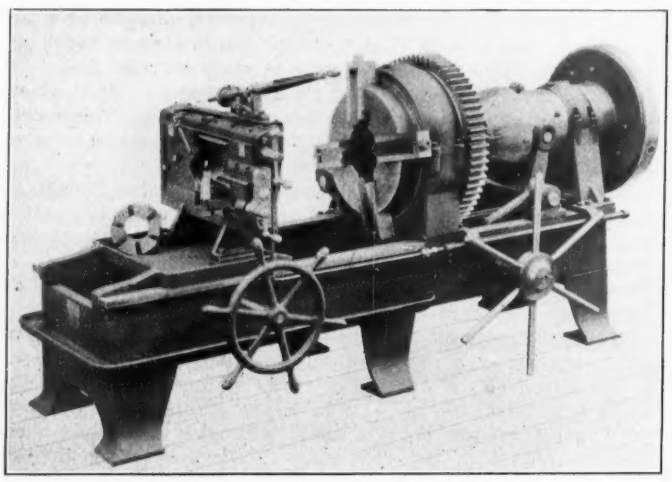
The present practice of displaying signals for following sections has become so firmly imbedded in the experience of railroad men that there would be a certain amount of danger in reversing it. What men have been accustomed to do through long years of practice, is what they may be expected to do instinctively. How far habit might outrun observance of a new practice is a question to be carefully considered.—*Train Dispatchers' Bulletin.*

Terminal Railroads' Wants.

The Buffalo Union Furnace Company, which controls the Buffalo Union Terminal Railway, has complained to the Interstate Commerce Commission that the railroads connecting with its short railroad do not make it proper allowances, and the amount demanded from each of the companies is named, as, for example: New York Central, $14,620; Lehigh Valley, $245; Erie, $6,193. It appears that the only legal ground offered to justify these claims is that these same roads pay $2.50 a car to similar industrial terminal railroads in other cities.

A New Size Pipe Threading Machine.

The Bignall & Keeler Manufacturing Co., Edwardsville, Ill., have placed on the market a new size pipe threading machine known as the P. D. Q. C. No. 6. It has a quick operating chuck, worked by a handwheel and pinion engaging a rack on the end of the cone



Bignall & Keeler Pipe Threading Machine.

shifting arm. The cone slides freely on the arbor, and as it is moved forward the chuck arms, having rollers in the ends, roll up on the large diameter of the cone, thereby tightening the jaws on the pipe. When the cone is moved back, springs draw the jaws away from the pipe. The steel jaws in the chuck are graduated and when once set for a size of pipe the entire lot can be threaded without stopping the machine. The rear chuck is provided with three independent jaws with which fittings can be made up; also bushings for keeping the pipe centered without gripping it. Eight changes of speed are obtained through a four-step cone pulley and shifting gears. The Peerless die-head is used. The machine has a range of 10 sizes, 1¼ in. to 6 in., inclusive.

Rules for Tracing Freight.

The Freight Bureau of the Business Men's League of St. Louis, after conferences with the principal railroads, has adopted the following recommendations concerning the tracing of freight:

1. That no tracers should be started until a complaint has been received from the consignee on account of non-arrival of the whole shipment or part thereof, and after a reasonable time has elapsed for consignment to reach destination.

2. That a printed form of tracer should be used, indicating: Name of consignee, destination, description of articles, number of packages, at what depot delivered, by whom dray ticket was signed, if possible; date on which shipment was receipted for; or in lieu thereof, an exact copy of dray ticket showing information as indicated above.

3. That tracers should state whether the entire shipment or part thereof has been unreasonably delayed, and, if part shipment, what item or items are short. This should be shown conspicuously, preferably in red ink, so as to be readily observed by the tracer clerk.

4 That all tracing for less than carload shipments forwarded from St. Louis should be done through one office of each railroad; said office to be designated by the individual carriers.

In accordance with the fourth recommendation, the railroads have designated certain offices through which tracing should be done.

Train Wreckers on the Pennsylvania.

The malicious wrecking of passenger trains on the Pennsylvania Railroad on March 22 and March 27 was followed by somewhat similar attempts on the lines of the same company in Ohio April 6 and 8, and at East Brady, Pa., April 7; and the company has announced further rewards for the apprehension of the guilty persons. The officers of the company are engaged in strenuous endeavors to stimulate the police and public and private detectives throughout the threatened territory to the utmost possible exertions, looking to the discovery of the culprits. The company proposes to put watchmen on every quarter mile of the line if necessary.

Manufacturing and Business.

The Chicago office of the Pantasote Co. has been moved from the Monadnock block to 707 Fisher building.

The Crocker-Wheeler Company, Ampere, N. J., has opened a branch office in the Woodward Building, Birmingham, Ala., in charge of B. A. Schroder, who hitherto has been in charge of the New Orleans territory of the company.

Reuben Wells has resigned as General Manager of the Rogers Locomotive Works (American Locomotive Co.). Fred. W. Cooke, who is Manager of the Cooke Works of the American Locomotive Co., will hereafter have charge of the Rogers Works also.

The B. F. Sturtevant Co., Boston, Mass., has just received from the Interborough Rapid Transit Company, New York, a repeat order for standard economizers. The previous order was for the equipment of 26,000 boiler horse-power. To complete both orders 11,200 tubes will be needed.

The offices of the Goldschmidt Thermit Co., New York, have been moved to the West street building, 90 West street, between Cedar and Albany streets, New York. The company has opened a Pacific Coast branch at 432-436 Folsom street, San Francisco, under the management of L. Heynemann, for business in California, Oregon, Washington and Nevada.

The Cincinnati Planer Co., Cincinnati, Ohio, has broken ground for its new plant at Oakley, Ohio, a suburb of Cincinnati, where an eight acres tract has been secured. The first building will be brick and steel, 140 ft. x 200 ft.; this will be equipped with new machinery throughout, and will be operated as an addition to the company's present plant, it being planned to build all the larger sizes in this new building. A second building, 140 ft. x 200 ft., will be erected as soon as the first addition is finished and put in operation; then the entire plant will be removed to the new location.

The Atlas Engine Works, Indianapolis, Ind., has been awarded the contract for the water-tube boilers for the new central power station to be built by the Government at Washington, D. C., which is to furnish heat, light and power for the capitol, the congressional library and the new senate and house office buildings. The station will be at Garfield Park, four blocks south of the capitol, at the intersection of New Jersey and E streets, and, it is said, will be the largest and most modern operated by the United States Government. J. G. White & Co., New York, are the consulting engineers on the work, the Government also having its own board of experts. The equipment will include sixteen 600 h.p. Atlas high-pressure water-tube boilers, equipped with Roney stokers, and four 2,000 k.w. Westinghouse-Parsons turbines and generators. Power and light will be distributed through four sub-stations, one being located in each of the buildings supplied. Deliveries are to begin August 1 and the plant is expected to be finished by the first of the year. The order for boilers is said to be the largest ever placed by the Government.

Iron and Steel.

The Canton-Hankow Railroad has ordered through Mitsui & Co., New York, 175 tons of 70-lb. rails.

There is no disposition to allow options on pig iron to lapse, leading consumers are closing contracts for a large tonnage every week, and no concessions in prices are considered. In addition to regular rates substantial premiums are paid for spot iron when it can be obtained. The supply of finished steel continues limited, the sheet mills only being able to make deliveries in from four to six months, and other sections of the market are not up with orders. Spring building is bringing out the expected demand for structural shapes, contracts for an enormous tonnage being now under consideration. Railroad bridge and terminal work is a prominent feature, and the mills do not experience the cancellations of orders that

were predicted, the money in most cases having been provided for the work under contract. Pipe mills cannot make deliveries within two months or more, and one new contract pending calls for 30 miles of 12-in. or over riveted steel pipe for irrigation in Nevada. Throughout the iron and steel industry there is a better tone than existed a few weeks ago, owing to the belief that the reaction in securities will go no further.—*Dun's Review.*

OBITUARY NOTICES.

R. X. Ryan, General Freight and Passenger Agent of the Northwestern Pacific, died recently of pneumonia at Oakland, Cal., after two months' illness.

William K. Niver, formerly Vice-President of the Boston & Maine, died at Syracuse on March 31. Mr. Niver was 72 years old. He began railroad work as Assistant Superintendent on the Delaware, Lackawanna & Western; he then went to the Syracuse, Binghamton & New York, now part of the D., L. & W., as Superintendent, and was afterwards General Superintendent of the Western district of the Lehigh Valley. After serving as Vice-President on the Boston & Maine, he organized a coal company. He was at one time Mayor of Syracuse.

E. J. Yard, the late Chief Engineer of the Denver & Rio Grande, who died last month, was born in Texas in 1860. He graduated from an eastern university and came to Colorado in 1880, where he began railroad work on the construction of the Denver & Rio Grande. He later went to Utah and then to the Rio Grande Western. He was afterwards appointed Chief Engineer of the Rio Grande Western, and was in charge of nearly all of the rebuilding of the road when it was made standard gage. In 1902 he was appointed Chief Engineer of the Denver & Rio Grande and of the Rio Grande Western.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

Association of Transportation and Car Accounting Officers.

The Secretary announces that at the request of a large number of the members of this association, the date of the annual meeting at St. Paul, Minn., has been changed to June 25-26, 1907.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Astoria & Columbia River.—C. M. Levey, Third Vice-President of the Northern Pacific, and President of the Portland & Seattle, which is under construction, has been elected also President of the Astoria & Columbia River.

Beaumont & Great Northern.—M. C. Booth has been appointed Auditor, with office at Onalaska, Tex.

Delaware & Hudson.—L. F. Loree, Chairman of the Executive Committee of the Kansas City Southern, has been elected also President of the Delaware & Hudson, succeeding David Wilcox, resigned.

Kansas City Southern.—See Delaware & Hudson.

Missouri, Kansas & Texas of Texas.—R. N. Roach has been elected Treasurer.

New York, New Haven & Hartford.—T. E. Byrnes, Vice-President, with office at New Haven, has been transferred to Boston, succeeding F. S. Curtis, who has been elected President of the Old Colony Railroad, succeeding C. F. Choate, resigned.

Northern Pacific.—See Astoria & Columbia River.

Panama Railroad.—Major G. W. Goethals, Chairman of the Isthmian Canal Commission, has been elected also President of the Panama Railroad, succeeding T. P. Shonts, resigned. E. E. Drake, Secretary, Treasurer and Assistant to the President, has been elected Vice-President. T. H. Rossbottom, Assistant Secretary, has been elected Secretary. Sylvester Demming, Assistant Treasurer, has been elected Treasurer. R. R. Rodgers has been elected General Counsel. The following new directors have been elected: G. W. Goethals, D. DuB. Gaillard, W. L. Sibert, W. C. Gorgas, Jackson Smith, H. H. Rosseau and J. C. S. Blackburn.

Portland & Seattle.—See Astoria & Columbia River.

Operating Officers.

Boston & Albany.—J. B. Stewart, General Superintendent, who was recently given leave of absence on account of ill health, has resigned, effective June 1.

Canadian Pacific.—See Grand Trunk Pacific.

Chicago, Indiana & Southern.—George Hannauer, Superintendent of the Wiggins Ferry Company, has been appointed Superintendent of the Danville division of the C., I. & S., and of the Indiana Harbor Belt.

Colorado & Southern.—J. D. Stack has been appointed Acting Superintendent of the Trinidad & New Mexico districts, with office at Trinidad, Colo., succeeding to the duties of J. D. Welsh, promoted.

Denver & Rio Grande.—A. F. Vick Roy, Assistant Superintendent of the Wyoming division of the Union Pacific, has been appointed Superintendent of the Colorado division of the Denver & Rio Grande.

Grand Trunk Pacific.—O. O. Winter, Superintendent of Terminals of the Canadian Pacific at Fort William, Ont., has been appointed General Superintendent of the Grand Trunk Pacific, with office at Winnipeg, Man.

Gulf, Colorado & Santa Fe.—K. S. Hull, Superintendent of the Texas & Gulf, has been appointed Superintendent of the Gulf, Colorado & Santa Fe at Temple, Tex., succeeding T. B. Coppage, resigned to go to the St. Louis & San Francisco.

Illinois Central.—J. F. Porterfield, Superintendent of the Yazoo & Mississippi Valley at Vicksburg, Miss., has been appointed Superintendent of the Louisiana division of the Illinois Central, with office at McComb City, Miss.

Mexican Central.—W. T. East has been appointed Acting Superintendent of Terminals at Tampico, Mex., succeeding to the duties of R. N. Elliott, who has been given leave of absence. L. W. Miller has been appointed General Track Inspector, with office at Mexico City, reporting to the General Superintendent.

Mobile, Jackson & Kansas City.—J. D. Patterson has been appointed Superintendent of the Mobile and Louisville divisions, with office at Laurel, Miss., succeeding J. G. Glazier, resigned to go to the Seaboard Air Line.

New York Central & Hudson River.—H. E. Brown, Trainmaster of the Hudson division, has been appointed Assistant Superintendent of that division, succeeding F. T. Slack, promoted. E. F. Wright, chief train despatcher of the Hudson division, has been appointed Trainmaster of that division.

Rio Grande Western.—E. Stenger has been appointed General Superintendent, with office at Salt Lake City, succeeding A. E. Welby, who remains General Superintendent of the Denver & Rio Grande.

St. Paul Union Depot.—J. W. Morrison has been appointed Superintendent, succeeding J. Strawhorn, resigned to go to another railroad company.

Seaboard Air Line.—J. G. Glazier, Superintendent of the Mobile division of the Mobile, Jackson & Kansas City, has been appointed Trainmaster of the Fourth division of the Seaboard Air Line, with office at Savannah, Ga.

Southern Pacific.—See this company under Traffic Officers.

Tehuantepec National.—C. Greene, Superintendent, has resigned and the office has been abolished.

Texas & Gulf.—M. T. Pratt, resident engineer of the Atchison, Topeka & Santa Fe at Temple, Tex., has been appointed Superintendent of the Texas & Gulf, succeeding K. S. Hull, transferred to the Gulf, Colorado & Santa Fe.

Union Pacific.—W. C. McKeown, Assistant Superintendent at Denver, Colo., has been appointed Assistant Superintendent of the Wyoming division, with office at Cheyenne, Wyo., succeeding A. F. Vick Roy, resigned to go to the Denver & Rio Grande.

Yazoo & Mississippi Valley.—A. C. Ferguson has been appointed Superintendent at Vicksburg, Miss., succeeding J. F. Porterfield, who has been appointed Superintendent of the Louisiana division of the Illinois Central.

Traffic Officers.

Atlanta, Birmingham & Atlantic.—J. R. Rowland, Traffic Manager of the Brunswick Steamship Company, has been appointed to the new office of Traffic Manager of the A. B. & A., with offices at New York and Atlanta, Ga.

Erie.—A. C. Hilton, General Agent at San Francisco, has been appointed General Agent at Cincinnati, Ohio, succeeding H. E. Huntington, transferred.

Mexican Central.—H. J. Snyder, Assistant General Freight Agent, has been appointed General Agent at San Francisco.

New York Central & Hudson River.—The authority of J. F. Fairlamb, General Passenger Agent of the New York Central & Hudson River, has been extended over the West Shore, C. E.

Lambert, General Passenger Agent of the West Shore, having retired on a pension. The authority of L. F. Vosburg, General Eastern Passenger Agent of the N. Y. C. & H. R., has been extended over the West Shore, H. B. Jagoe, General Agent, having resigned to go into other business.

Pennsylvania Lines West.—J. B. Modisette, Assistant General Passenger Agent at Cleveland, Ohio, has been appointed Chief Assistant General Passenger Agent, with office at Pittsburg, Pa., succeeding F. Van Dusen, deceased. J. K. Dillon, District Passenger Agent at Pittsburg, succeeds Mr. Modisette.

Rutland.—Clare Hartigan has been appointed General Agent at Montreal, succeeding Frank Barbour, promoted.

Southern.—W. C. Harrison, New England Agent, has been appointed General Agent at New York, succeeding J. B. Munson, promoted.

Southern Pacific.—F. W. Hoover has been appointed Industrial Agent in charge of San Francisco Bay territory, and such other territory as may be assigned to him. He will co-operate with the traffic department, and will report to the General Manager.

Engineering and Rolling Stock Officers.

Cumberland Valley.—Tabor Hamilton has been appointed Master Mechanic, succeeding J. B. Diven, transferred to the Pennsylvania. See Pennsylvania.

Lehigh Valley.—A. C. Adams has been appointed Master Mechanic of the Pennsylvania division, succeeding John McMullen, resigned.

Northern Pacific.—L. S. Oakes has been appointed Division Engineer of the Idaho and Pasco divisions, with office at Spokane, Wash., succeeding T. H. Croswell, transferred. The authority of F. J. Taylor, Division Engineer at Livingston, Mont., has been extended to Trout Creek, Wash. L. M. Perkins has been appointed Division Engineer at St. Paul, in charge of the lines east of Staples. The title of resident engineer has been changed to Assistant Engineer.

Pennsylvania.—J. B. Diven, Master Mechanic of the Cumberland Valley, has been appointed Assistant Engineer of Motive Power of the New Jersey grand division of the Pennsylvania.

LOCOMOTIVE BUILDING.

The Tidewater is reported to be figuring on additional locomotives.

The Philadelphia & Reading is said to have ordered 10 Atlantic (4-4-2) type locomotives.

The Quitman Lumber Co., Quitman, Ga., is said to be in the market for one 18 to 30-ton locomotive.

The Tidewater, as reported in the *Railroad Gazette* of April 5, has ordered four locomotives from the Baldwin Locomotive Works for July delivery, and four 10-wheel (4-6-0) type passenger locomotives from the American Locomotive Co. for May and June delivery.

The Spokane & Inland has ordered eight 72-ton single phase electric locomotives from the Westinghouse Electric & Manufacturing Co. Each will be equipped with four 250 h.p. motors, the engines being of the same type as those built for the New York, New Haven & Hartford.

CAR BUILDING.

The Quitman Lumber Co., Quitman, Ga., is said to be in the market for logging cars.

The Northwestern Pacific is in the market for 10 passenger coaches and one baggage car.

The El Paso Electric has ordered four interurban cars and four open cars for delivery by June 1.

The Woeber Carriage Co., Denver, Colo., is asking prices on equipment for four electric cars.

The Texas Central, it is understood, has ordered 100 box cars from the American Car & Foundry Co.

The United States Steel Corporation's subsidiary railroads are understood to be in the market for 8,000 cars.

The Sierra Madre Land & Lumber Co., New York City, has ordered 150 box cars from the Pullman Company.

The National Tube Co., Pittsburg, Pa., it is reported, has ordered six steel flat cars from the Youngstown Car Manufacturing Co.

The Tonopah & Goldfield has ordered six cabooses from the Pullman Company, and is reported to be in the market for 150 box cars.

The Chicago & Illinois Western, as reported in the *Railroad Gazette* of February 8, has ordered 300 gondola cars of 100,000 lbs. capacity from Haskell & Barker.

The Mobile & Ohio has ordered 1,000 box cars of 60,000 lbs. capacity, and 750 gondola cars of 80,000 lbs. capacity from the American Car & Foundry Co. for October, November and December delivery.

The St. Louis, Rocky Mountain & Pacific has ordered 300 gondola cars of 80,000 lbs. capacity from the American Car & Foundry Company. These cars will weigh 32,000 lbs., and will measure 35 ft. 7 in. long, 9 ft. 4 in. wide and 3 ft. 11¾ in. high, inside measurements. The special equipment includes:

Brakes	Westinghouse
Brake-beams	Monarch
Couplers	Tower
Draft rigging	Miner
Dust guards	Harrison
Journal boxes	McCord

The Mississippi Central, as reported in the *Railroad Gazette* of February 22, has ordered 100 box cars of 60,000 lbs. capacity, for June, 1907, delivery, from the American Car & Foundry Co. These cars will weigh 33,500 lbs., and will measure 36 ft. ½ in. long, 8 ft. 6⅛ in. wide and 9 ft. ⅜ in. high, inside measurements, and 36 ft. 10 in. long, 9 ft. ¾ in. wide and 13 ft. $11^{5}/_{16}$ in. high, over all. Bodies and underframes will be of wood. The special equipment includes:

Bolsters	Scullin & Gallagher
Brake-beams	Simplex, inside hung
Brake-shoes	American Car & Foundry Co.
Brasses	Ajax plastic bronze
Couplers	R. E. Janney
Door fastenings	National Malleable
Draft rigging	Miner
Paint	American Car & Foundry Co.
Roofs	Chicago, old style
Springs	Phoenix
Trucks	Wolff truck frames
Wheels	American Car & Foundry Co.

RAILROAD STRUCTURES.

Bucyrus, Ohio.—The Toledo & Ohio Central, it is said, has started work on a shop building 80 x 800 ft.

Calgary, Alb.—The Alberta Government will put up steel bridges this year as follows: Medicine Hat, to cost $82,000; Old Man river north of Pincher, $20,000; Bow river, Calgary, $25,000; over the same river south of Gleichen, $35,000; Old Man river near Kipp, $15,000; Red Deer river at Red Deer, $25,000; Sheep Creek in High river district, $25,000; over the north fork of the same creek, $8,000; Red Deer river, Rosebud district, $30,000. Hon. W. H. Cushing, Calgary, may be addressed.

Jacksonville, Fla.—The Seaboard Air Line shops at this place will include a machine and erecting shop 117 ft. x 380 ft. Other buildings include one 66 ft. x 260 ft., with a 60-ft. x 66-ft. extension; another 61 ft. x 181 ft. A car shop 90 ft. x 300 ft., axle and smith shop 28 ft. x 150 ft., boiler and engine room 63 ft. x 122 ft., and planing mill 50 ft. x 176 ft. There is also to be a large roundhouse.

Lewiston, Idaho.—The Northern Pacific and the Oregon Railroad & Navigation Company are building a union passenger station here to cost about $100,000, and are also extending the yards. It is thought that upon the completion of the yards the Northern Pacific will make Lewiston a division point for all traffic north as far as Garfield, Washington. This is taken to mean that grain will be sent via Lewiston to the coast, as was announced by Vice-President Levey some time ago.

Moose Jaw, Sask.—The Canadian Pacific, it is reported, has bought about 30 acres of land as a site for new yards. Plans have also been made for putting up a large hotel by the railroad to cost $175,000.

Ottawa, Ont.—The Trans-Continental Railway Commission is asking bids May 1, for six steel bridges as follows: Wabijon and Winnipeg river, Canadian Railway crossing, Whitemouth river, Brokenhead river (east and west branches). Address the Chief Engineer at Ottawa.

Pierre, S. Dak.—The Chicago & North-Western is planning to put up a new station here to cost $125,000, and has plans made for shops, roundhouses and other improvements to cost an additional $175,000.

St. Clair, Pa.—The Philadelphia & Reading, it is said, is planning to at once put up new shops and establish a yard at this place.

Scranton, Pa.—The Delaware, Lackawanna & Western has started work on its shops here to cost about $2,000,000. The buildings include: A foundry, 120 ft. x 400 ft.; blacksmith shop, 125 ft. x 300 ft.; storehouse and office, 65 ft. x 325 ft. Other buildings to be built later but included in the original plans are: Machine, boiler and tank shop, 346 ft. x 582 ft.; paint shop, 90 ft. x 162 ft.; repair shop, 80 ft. x 250 ft.; power house, 90 ft. x 160 ft.; laboratory, 40 ft. x 70 ft., and scrap platform, 40 ft. x 400 ft. In addi-

tion there will be a roundhouse and some smaller buildings. These shops are being built on a tract of about 25 acres.

WINNIPEG, MAN.—Plans are being made for a combined station and hotel to be built here for the Grand Trunk Pacific and the Canadian Northern. The estimated cost is $3,500,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALABAMA TERMINAL.—Incorporated in Alabama, to build from Birmingham, Ala., to Gate City, 10 miles. L. C. Bradley is President, and A. W. Brazelton, Secretary, Birmingham.

AMERICAN RAILROAD OF PORTO RICO.—An officer writes that this company has finished its new connecting line from the western end of the line on the north coast at Camuy west, thence south to Aguadilla, 27 miles, to the line south along the west coast and thence to Ponce.

Work is under way on a cut-off from Hormigueros, state of Mayaguez, south to Lajos, 12 miles; also on an extension of the main line from Ponce east to Coamo, 23 miles. (March 15, p. 379.)

BALTIMORE & OHIO.—The Maryland Court of Appeals recently rendered a decision that the legislation enacted in 1906 to prohibit this company from building its proposed line around Baltimore, was inoperative. According to reports, the company will at once begin the work. (March 15, p. 380.)

BRUNSWICK & MIDDLETOWN (ELECTRIC).—Contracts, it is reported, are to be let early in June for building this proposed line from Brunswick, Md., to Middletown, 15 miles. Preliminary surveys made and almost the entire right of way secured. John S. Mallette, Brunswick, Md., Chief Engineer.

CANADIAN NORTHERN.—According to reports from Winnipeg, this company will shortly resume work on the line from Brandon, Man., west to Regina, Sask.; from Etoimami, Sask., northeast to the Pas, and on the Rossburn branch northwest from Neepawa.

CHICAGO & NORTH-WESTERN.—Work has been started on track elevation within the city limits of Chicago, which is to be finished this year at a cost of over $2,000,000. The most extensive project is the extension of elevated tracks from Balmoral avenue north to the Chicago-Evanston line, through Rose Hill, High Ridge, and Rogers Park, three miles. This will cost $1,250,000, not including a new station to be built at Rose Hill for about $30,000, and also a new station at High Ridge. When this work is completed the company will have three tracks elevated from the river to the northern boundary of the city, seven miles. Eighteen under crossings will be made in the three miles to be elevated. Nearly 400 men are now at work, and the number is to be increased to 1,000 shortly.

Work has also just been started elevating the tracks from the east line of Loomis street to the west line of Canal street, 1.14 miles. The estimated cost of this work is $875,000, including a retaining wall of solid masonry 800 ft. long and 16 ft. high.

DENVER & RIO GRANDE.—Preliminary surveys are reported being made by this company for an extension from Farmington, N. Mex., south to Gallup, about 100 miles, which is on the Atchison, Topeka & Santa Fe.

GALVESTON TERMINAL.—This company, which is controlled by Rock Island-Frisco interests, has taken the first step toward the improvement of its property on Galveston island which is to serve for the extensive terminal facilities of these lines. Bids have been invited for the placing of about 600,000 cu. yds. of filling. These bids were to be opened this week and the contracts awarded soon. Commencing at Twenty-ninth street, the filling will extend to the south end of the bay bridge, 4½ miles. The company expects to build the largest cotton transferring platform in Texas, just outside the city limits. It will be 1,200 ft. long and 200 ft. wide.

GRAND TRUNK.—Contract is reported let to McRae, Chandler & McNeil for double-tracking this road between St. Lambert and Ste. Rosalie, 33 miles. The work to be completed this fall.

ILLINOIS TRACTION.—According to reports from St. Louis, this company, otherwise known as the McKinley Syndicate, has organized the St. Louis Electric Terminal, and will make improvements in St. Louis to cost about $5,000,000. The plans call for a bridge over the Mississippi river, from St. Louis to Venice, Ill., to consist of three central spans of 521, 523 and 521 ft. respectively, with two shore spans each 300 ft. long, all to have a clearance of 75 ft. above low water. It is to have two tracks for street railroads with roadways and sidewalks on each side, and is to cost about $2,500,000. Three passenger stations and one express station are to be put up at a cost of $200,000, and other buildings to cost $1,600,000. The land for the stations will cost about $700,000.

KANSAS CITY, OKLAHOMA & GULF.—Incorporated in Texas with a capital of $125,000 and office at Athens. The company proposes to build a line from Athens, Tex., in Henderson County, north to the Red river, in Lamar County, about 110 miles. The incorporators are: A. C. Springs, of Kansas City, Mo.; J. E. Owens, of Wills Point; J. W. Davidson, of Grand Saline; John A. Underwood, E. E. Blocker and W. S. Evans, all of Honey Grove; J. T. LaRue and J. B. Wofford, of Athens, and I. Jalonick, of Dallas, Texas.

LAKE ERIE & YOUNGSTOWN.—Incorporated in Ohio, to build a line from Conneaut, Ohio, south to Youngstown, 60 miles. G. M. Brown, W. F. Stanley, G. J. Chapman, F. J. Cheney, J. H. Ruhlman, W. H. Ruhlman and A. W. Jones, incorporators.

LONG ISLAND.—A special committee appointed by the New York City Board of Estimate and Apportionment has filed a report on the application of this company to move its tracks on the section of its road from Manhattan Beach Junction to Manhattan Beach, to the embankment on which are the four tracks of the Brighton Beach line. This part of the Bay Ridge improvement for the elimination of grade crossings is being carried out under the direction of the Brooklyn Grade Crossing Commission. If permission is granted there will be six tracks on the same embankment. The original plans provided for two parallel embankments three miles long and 500 ft. apart. The Grade Crossing Commission favors the use of one embankment for both roads.

The Bay Ridge waterfront station of the Sea Beach Railway, between Sixty-third and Sixty-fourth streets, Brooklyn, has been finished, and the company is now ready to start work there on a large freight terminal. This is to be the western terminus of the New York Connecting Railroad, where cars are put on boats to be sent to the Pennsylvania yard at Greenville, N. J. Contracts for piers and float bridges are reported let, and work is to be started at once. The yard will have a frontage on the upper bay of 565 ft., extending to Fifth avenue between Sixty-fourth and Sixty-fifth streets. About 40 parallel tracks are to be laid, west of First avenue, to have a capacity of 1,800 cars. There is to be a pier 600 ft. long with four tracks.

MANUFACTURERS' TERMINAL.—This company, recently chartered with $200,000 capital at Harrisburg, Pa., to build a 20-mile belt line connecting the various railroad lines in Erie, has begun active work on surveys. The proposed route is from a junction with the railroads at Four-Mile creek, south to the old Mill road, and to Glenwood, skirting the foot of the hill, thence west to where it again connects with the railroads. This circuit will connect the Lake Shore, Nickel Plate and Pennsylvania roads on the east, and the Bessemer, Pennsylvania, Lake Shore and Nickel Plate on the west, and will prove of great advantage to manufacturers. The Directors are George R. Metcalf, Frank Connell, George T. Bliss, Benjamin J. Walker, Ed. G. Germer, Charles E. Shenk, Henry E. Fish and John R. McDonald. President, George R. Metcalf; Vice-President, Frank Connell; Secretary, John S. Rilling, and Treasurer, John R. McDonald.

MISSOURI, ARKANSAS & SOUTHWESTERN.—An extension of time has been granted this company to complete its road, now building from Batesville, Ark., northeast to Black Rock, 52 miles. (March 15, p. 387.)

MISSOURI PACIFIC.—Reports are being revived in Memphis, Tenn., that this company is to begin work this summer on a 50 mile cut-off between Memphis and Marianna, Ark. Surveys between these points were made several years ago. If this line is built it will shorten the distance to New Orleans over this road by about 50 miles. The present route from Memphis includes a long detour west by way of Wynne, Ark., thence south to Marianna, about 100 miles. The rights of way have all been secured and cleared off.

NEW YORK SUBWAYS.—The Rapid Transit Board of New York City has received a plan from the Interborough Company for a change of track at the Ninety-sixth street subway station. The plans call for the removal of certain tracks and for building three additional tracks. The city will be asked to pay for the improvements, which will cost about $850,000.

Bids are wanted April 25, by the Board of Rapid Transit Railroad Commissioners, 320 Broadway, New York, for the construction of rapid transit railroads (subways) for the Lexington avenue line, and for the Seventh and Eighth avenue lines. See *Railroad Gazette*, Jan. 4, 1907, p. 22.

OREGON & SOUTHEASTERN.—An officer writes that this company is building with its own men, an extension from Disston, Ore., southeast to Bonita, 6½ miles.

PARRAL & DURANGO.—This company, it is said, has completed grading on an extension of its road, from Mesa de Sandia, Durango, Mexico, for about 12 miles. R. M. Dudley, Chihuahua, Mex., is the contractor.

PENSACOLA, ALABAMA & WESTERN.—See Pensacola & Northeastern.

PENSACOLA & NORTHEASTERN.—Surveys are reported being made by this company for its proposed line from Andalusia, Ala., south-

west to Pensacola, Fla., 100 miles, and it is said that construction work is soon to be started. The promoters include: J. L. Miller, C. M. Gordon, W. F. Scott and J. E. Habach, with office at Pensacola. The same interests, it is said, are promoting the Pensacola, Alabama & Western, projected from Pensacola to Meridian, Miss., and Memphis, Tenn.

Perkiomen Traction.—Under this name a company is being organized in Pennsylvania to build an electric line through the Perkiomen valley, 11½ miles. I. H. Bartman, of Schwenkville; H. T. Hunsicker, of Ironbridge; G. Dunn, S. E. Hughes and J. H. Dager, of Norristown, are interested.

Plum Valley Railway.—Incorporated in South Dakota, with $500,000, to build from Pepin, Wis., north to Plum City, 22 miles. P. M. Ingold and H. A. Platt, of Plum City, Wis.; S. A. Cockerill and E. Dufond, of Washington, D. C.; P. L. Dotson and A. Dugellay, of Pierre, S. Dak., are incorporators.

Rockingham & Caswell.—Under this name a company is being organized in North Carolina to build from Yanceyville, N. C., west through Rockingham County, via Reidsville and Wentworth to Stoneville, 45 miles. R. T. Williams, Reidsville, is interested.

St. Louis Electric Terminal.—See Illinois Traction.

Sandusky, Fremont & Southern.—A contract is reported let to George Kinney, of Fremont, Ohio, to build this proposed line from Fremont to Vickery, 10 miles. The line is projected from Sandusky, Ohio, to Fremont, 30 miles. The contract calls for the completion of the work by June 1, 1907. (March 15, p. 391.)

Saskatchewan Central.—This company, which proposes to build a main line from the Manitoba boundary west through the southern part of the Cannington district, via Willow Bunch to Alberta, has asked permission to build lines from the main line south of Regina, in a north and westerly direction through the Goose Lake country. J. H. Sheppard has introduced a bill for this purpose.

Seaboard Air Line.—Surveys are reported being made by this company between Norlina, N. C., and Hamlet, to shorten the line and reduce grades and curves. Contract reported let to the E. L. Propst Contracting Co., of Charlotte, N. C., for five miles of passing tracks between Norlina and Raleigh.

President Garrett is quoted as saying that contracts for improvements amounting to $12,000,000 have been let. About $250,000 is to be spent at Wilmington, N. C., in terminal facilities. About $1,000,000 will be spent in North Carolina.

Toledo, Wabash & St. Louis (Electric).—This company proposes to build a line from Toledo, Ohio, via Defiance, Fort Wayne, Ind.; Indianapolis and Terre Haute to St. Louis Mo., about 400 miles. An officer writes that they propose to start work abut July 1. C. D. Whitney, Toledo, Ohio, is President. (April 5, p. 500.)

Velasco, Brazos & Northern.—This company, it is reported, is planning to build an extension of its road from Anchor, Tex., north. Work is to be started this summer.

RAILROAD CORPORATION NEWS.

Baltimore & Ohio.—See Washington Terminal.

Boston & Maine.—See Maine Central.

Buffalo & Susquehanna.—The New York Stock Exchange has listed $2,408,000 additional first refunding mortgage 4 per cent. bonds of 1951 of this company, making $11,256,000 outstanding. The greater part of these additional bonds were issued for the following purposes: $1,164,000 for additional equipment and $1,240,000 for buying and developing coal lands.

Buffalo, Rochester & Pittsburg.—A special meeting of the stockholders has been called for April 25 to authorize $35,000,000 50-year consolidated mortgage bonds drawing not more than 4½ per cent. interest. The purposes of the new issue are said to be as follows: $3,000,000 for present corporate uses; $18,145,000 for refunding; and $13,855,000 to be issued after July 1, 1908, in amounts not exceeding the rate of $1,500,000 per year unless the stockholders specially authorize a larger issue in any one year. The $3,000,000 is to provide for construction under way or projected and equipment not provided for otherwise.

Central Vermont.—See New York, New Haven & Hartford.

Erie.—This company has sold to J. P. Morgan & Co., $5,500,000 one year notes. The notes were resold to other bankers, who offered them to the public at 93. As it is understood that J. P. Morgan & Co. sold them for 91, it is evident that they were sold by the railroad company for not more than 90, so that the company got less than $5,000,000 cash, and the cost of the note issue to it is about 11 per cent. The notes were used in part to refund $3,000,000 notes which fell due on April 8, and it is supposed that the remainder will be used to take care of $2,000,000 notes maturing within a few months.

Gainesville & Gulf.—See Tampa & Jacksonville.

Grand Trunk.—See New York, New Haven & Hartford.

Houston & Brazos Valley.—This company has been incorporated with $120,000 capital stock to take over and operate the Velasco, Brazos & Northern, which runs from Velasco, Tex., to Anchor, 20 miles, and to extend it northeast to a connection with the Houston & Texas Central, about 120 miles.

Houston & Texas Central.—See Houston & Brazos Valley.

Maine Central.—This company is to buy the Somerset Railway for a price said to be $600,000. The Somerset owns 42 miles of road from Oakland, Me., on the Maine Central, to Bingham, and has finished 35 miles of a 54-mile extension from Bingham to Birch Point. The extension makes a connection with the Canadian Pacific near Moosehead. The capital stock is $736,649 and the bonded debt is $1,261,500. The Boston & Maine controls the Maine Central through stock ownership.

New York Central Lines.—Gross earnings for the month of March, 1907, were as follows:

New York Central & Hudson River	$7,814,163	Inc.,	$289,801
Lake Shore & Michigan Southern	3,700,694	Inc.,	116,484
Lake Erie & Western	405,400	Dec.,	47,782
Chicago, Indiana & Southern	271,456	Inc.,	32,405
New York, Chicago & St. Louis	958,686	"	131,515
Michigan Central	2,350,704	"	147,295
Cleveland, Cincinnati, Chicago & St. Louis	2,014,521	"	105,667
Peoria & Eastern	231,870	Dec.,	17,445
Cincinnati Northern	76,586	"	3,177
Pittsburg & Lake Erie	1,077,048	"	92,244
Rutland	221,901	Inc.,	20,263
Total	$19,123,029	Inc.,	$682,782

New York Central & Hudson River.—The annual report for the year ended December 31, 1906, shows gross earnings of $92,089,969, an increase of $5,994,167; betterments and new equipment to the amount of $1,308,261 are included in operating expenses, making the net earnings $25,827,813, an increase of $1,232,962. Other income increased from $6,523,499 to $7,707,738, due mostly to the increased Lake Shore and Michigan Central dividends. The surplus after dividends was $3,134,762, an increase of $1,021,414; from this amount $2,800,000 was set aside as a special fund for new equipment and betterments.

New York, New Haven & Hartford.—This company is surveying a line from Southbridge, Mass., to Palmer, where a connection will be made with a line of the Central Vermont, which is controlled by the Grand Trunk. Traffic agreements have been made between the New York, New Haven & Hartford and the Central Vermont, which will, when the connecting line is built, give the New Haven an outlet to the west over the Grand Trunk.

Pennsylvania.—See Washington Terminal.

Somerset Railway.—See Maine Central.

Tampa & Jacksonville.—This is the new name of the Gainesville & Gulf, which runs from Sampson City, Fla., to Fairfield, 48 miles, and is building extensions from Sampson City northeast to Jacksonville, 50 miles, and from Fairfield south to Tampa, 150 miles.

Toledo Railway & Terminal.—The United States Circuit Court at Toledo, Ohio, has ordered the foreclosure of the mortgage for $3,773,598 held by the Commonwealth Trust Co. of St. Louis. The minimum selling price is to be $2,000,000. The company was put into the hands of a receiver early in January, 1906, as a result of the C., H. & D. and Pere Marquette receiverships. The two last named companies guaranteed the bonds issued under the above mortgage.

Velasco, Brazos & Northern.—See Houston & Brazos Valley.

Wabash.—This company has sold to Tailer & Co., New York, $6,160,000 two-year 5 per cent. notes to refund $6,160,000 three-year collateral 5 per cent. notes maturing on May 10. It is believed that the notes were sold at a price which made the cost of the money to the company 8½ per cent. The old notes were secured on the $10,000,000 stock of the Wabash-Pittsburg Terminal and on $6,600,000 of the $29,500,000 50-year first mortgage 4 per cent. bonds of that company. The new notes are secured on the same collateral and also on $4,800,000 Wabash refunding mortgage 4 per cent. bonds of 1956.

Washington Terminal.—The syndicate formed in February, 1905, to underwrite the $10,000,000 3½ per cent. first mortgage bonds of 1945 has been dissolved. The bonds, which are guaranteed by the Baltimore & Ohio and the Pennsylvania, were taken by the syndicate at 96⅜, and offered to the public at 97½. The present market value is about 90. The syndicate sold only 47 per cent. of the securities, and the remainder will now be distributed among the participants.